Vol. 9, No. 23
December 15, 1984

Energy Research Abstracts

Abstracts 47239-49327

Technical Information Center
Office of Scientific & Technical Information
UNITED STATES DEPARTMENT OF ENERGY

CURRENT AWARENESS PUBLICATIONS ON ENERGY

To provide complete coverage of literature related to major Department programs, announcement publications that are comprehensive in their coverage of certain energy fields are issued regularly. All information in these publications, plus additional backup information, is included in the Energy Data Base of the Technical Information Center; all references are also available for machine searching via the on-line retrieval system, DOE/RECON, and the commercial on-line retrieval systems. Descriptions of these current awareness publications, which are supported either directly or indirectly by the DOE, appear below. Department of Energy components may receive the listed publications free from the Technical Information Center, Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831. Telephone (615) 576-1301; FTS 626-1301.

PUBLICATIONS OF THE TECHNICAL INFORMATION CENTER

Energy Abstracts for Policy Analysis (EAPA)

A monthly abstract journal devoted to the analysis of energy research, conservation, and policy. Scope and coverage are limited to substantive articles or reports and emphasize the following programmatic efforts; legislative, regulatory, and other legal aspects; social, economic, and environmental impacts; regional and sectoral analyses; institutional factors, etc. *EAPA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402; domestic subscribers $5.00, foreign $6.25 per copy; annual cumulative index, domestic $16.00, foreign $20.00 per copy. The annual subscription price is $72.00 for domestic subscribers and $90.00 for foreign subscribers.

Energy Research Abstracts (ERA)

A comprehensive semimonthly abstract journal devoted to all areas of energy-related information produced by the Department of Energy, other U. S. government organizations, and foreign governments. *ERA* is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues is $165.00 for domestic subscribers and $206.25 for foreign subscribers. A single issue costs $9.50 (domestic) or $11.90 (foreign).

DOE Patents Available for Licensing (PAL)

DOE is prepared to grant exclusive or nonexclusive, revocable licenses under DOE-owned U. S. patents and patent applications; this semiannual publication provides abstracting and indexing coverage of this literature. *PAL* is available on subscription as PB84-946800 from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. The annual subscription price is $14.00 for domestic subscribers and $28.00 for subscribers outside the North American continent; prices for single issues are $7.00 and $14.00, respectively.

The following monthly update journals are available to the public on subscription from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161; use the identifying order number (PB- No.) when subscribing. The annual subscription rate for one volume (calendar) year (12 issues plus cumulative index) is $75.00 for domestic (North America) and $150.00 for foreign (outside North America) subscribers. A single issue is $7.00 (domestic) and $14.00 (foreign).

***Current Energy Patents (CEP)*–PB84-902800**

Provides coverage of the international patent literature, including patent applications, that concerns any aspect of energy production, conservation, and utilization.

***Energy and the Environment (EAE)*–PB84-914900**

Devoted to information on the impacts of energy-related activities and radioactive and nonradioactive pollutants on the environment.

***Fossil Energy Update (FEU)*–PB84-914600**

Devoted to information on the exploration, development, processing, and use of fossil fuels.

***Fusion Energy Update (CFU)*–PB84-915300**

Devoted to information on controlled thermonuclear fusion, including plasma and fuel research and power plant engineering and conceptual design studies.

***Solar Energy Update (SEU)*–PB84-914500**

Devoted to information on the utilization of solar energy, including biomass and tidal and wind power.

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***Acid Precipitation (APC)*–PB84-901000**

Covers all aspects of acid precipitation, including effects and possible control measures.

***Coal-Based Synfuels (CBS)*–PB84-901400**

Covers all aspects of conversion of coal into gaseous or liquid fuels.

***Coal Preparation and Pollution Control (CPC)*–PB84-900800**

Covers all aspects of coal preparation and cleaning and reducing pollution from its direct combustion.

***Direct Energy Conversion (DEC)*–PB84-946600**

Covers the following areas: photovoltaics, magnetohydrodynamics, electrohydrodynamics, thermoelectrics, thermionics, and fuel cells.

***Geothermal Energy Technology (GET)*–PB84-914700**

Devoted to information on the exploration, development, and utilization of geothermal resources.

***Laser Research (LAR)*–PB84-901100**

Covers all aspects of laser research and development, but excludes applications.

***Nuclear Fuel Cycle (NFC)*–PB84-913400**

Covers all aspects of the nuclear fuel cycle, both front end and back end.

***Nuclear Reactor Safety (NRS)*–PB84-913500**

Covers the following safety aspects: accident analysis, safety systems, radiation protection, decommissioning and dismantling, and security measures.

***Radioactive Waste Management (RWM)*–PB84-902900**

Covers the following management aspects: transport and storage, waste processing, waste disposal, waste storage, radioactive effluents, and shipping containers.

***Solar Thermal Energy Technology (STT)*–PB84-901200**

Covers research in materials, concentrators/receivers, salinity gradients, etc., for development of efficient and reliable solar thermal conversion systems.

***Unconventional Petroleum (UCP)*–PB84-901300**

Covers all aspects of secondary and tertiary recovery of petroleum and of oil shales and tar sands.

INTERNATIONAL ENERGY PUBLICATIONS

The Office of Scientific and Technical Information, Technical Information Center (TIC) cooperates with the following organizations in the publication of international abstract journals: (1) International Atomic Energy Agency, International Nuclear Information System, Vienna, Austria, for *Atomindex;* (2) International Energy Agency, IEA Coal Research, London, England, for *Coal Abstracts;* and (3) International Energy Agency, Biomass Conversion Technical Information Service, Dublin, Ireland, for *Biomass Abstracts.* In each case, the cognizant foreign agency provides the non-U.S. information to TIC for inclusion in the Energy Data Base; in turn, TIC provides the U. S. information for input into the respective journal.

Atomindex

A semimonthly abstract journal providing worldwide coverage of information on nuclear science and technology. *Atomindex* is available by subscription from UNIPUB, 345 Park Avenue South, New York, NY 10010. The cost of an annual subscription, 24 semimonthly issues and semiannual and annual cumulative indexes, is $290.

Biomass Abstracts

A bimonthly abstract journal with comprehensive coverage of information in any step involved in the eventual conversion of biomass to energy. *Biomass Abstracts* is available free to Department of Energy components and contractors from the Technical Information Center. Non-DOE organizations may obtain *Biomass Abstracts* from Biomass Conversion Technical Information Service, Institute for Industrial Research and Standards, Ballymun Road, Dublin 9, Ireland, for 42 IR pounds per year. Make checks payable to the Institute.

Coal Abstracts

A monthly abstract journal providing comprehensive worldwide coverage of information in the field of coal science and technology. *Coal Abstracts* is available to Department of Energy components and contractors from the Technical Information Center. Non-DOE organizations may obtain *Coal Abstracts* from IEA Coal Research, Technical Information Service, 14-15 Lower Grosvenor Place, London SW1W 0EX, England, for 100 pounds sterling per year.

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ENERGY RESEARCH ABSTRACTS

ABOUT THE TECHNICAL INFORMATION CENTER

The Office of Scientific and Technical Information, Technical Information Center in Oak Ridge, Tennessee, has been the national center for scientific and technical information for the Department of Energy (DOE) and its predecessor agencies since 1946. In developing and managing DOE's technical information program, the Center places under bibliographic control not only DOE-originated information but also worldwide literature on scientific and technical advances in the energy field and announces the source and availability of this information. Whereas the literature of science is emphasized, coverage is extended to DOE programmatic, socioeconomic, environmental, legislative/regulatory, energy analysis, and policy-related areas. To accomplish this mission, the Center builds and maintains computerized energy-information data bases and disseminates this information via computerized retrieval systems and announcement publications such as abstracting journals, bibliographies, and update journals. Direct access to the Center's most comprehensive data base, the Energy Data Base, is available to the public through commercial on-line bibliographic retrieval systems. The Energy Data Base and many of the Center's energy-related data bases are available to DOE offices and contractors and to other government agencies via DOE/RECON, the Department's on-line information retrieval system. The Center has developed and maintains systems to record and communicate energy-related research-in-progress information, to maintain a register of DOE public communications publications, to track research report deliverables from DOE contractors, and to test and make available DOE-funded computer software programs with scientific and management applications. The Center also maintains a full-scale publishing capability to serve special publication needs of the Department. To effectively manage DOE's technical information resources, the Center's program is one of continual development and evaluation of new information products, systems, and technologies.

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Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.

ERA is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

ERA is available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Inquiries should be directed to the Office of Scientific and Technical Information, Technical Information Center, P. O. Box 62, Oak Ridge, TN 37831.

ERA is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues is $165.00 for domestic subscribers and $206.25 for foreign subscribers. A single issue costs $9.50 (domestic) or $11.90 (foreign). The cumulative indexes will be available in printed form from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402, and in microfiche form from the National Technical Information Service, U. S. Department of Commerce, Springfield, VA 22161, and from Engineered Systems, P. O. Box 866, Oak Ridge, TN 37831.

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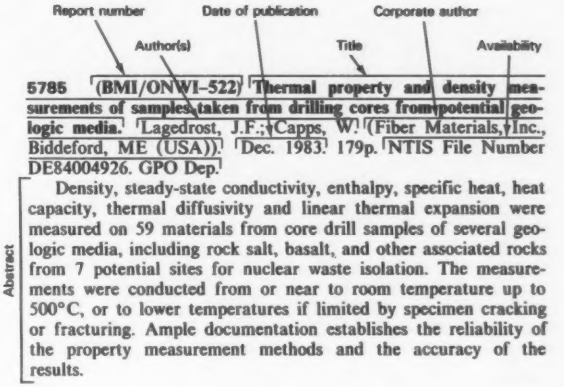
HOW TO USE *ENERGY RESEARCH ABSTRACTS*

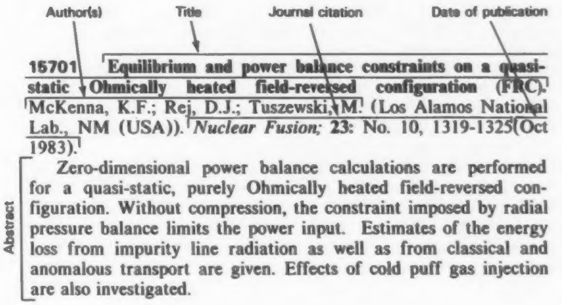
ABSTRACTS IN *ENERGY RESEARCH ABSTRACTS*

The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.



5785 **(BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media.** Lagedrost, J.F.; Capps, W. (Fiber Materials, Inc., Biddeford, ME (USA)). Dec. 1983. 179p. NTIS File Number DE84004926. GPO Dep.

Density, steady-state conductivity, enthalpy, specific heat, heat capacity, thermal diffusivity and linear thermal expansion were measured on 59 materials from core drill samples of several geologic media, including rock salt, basalt, and other associated rocks from 7 potential sites for nuclear waste isolation. The measurements were conducted from or near to room temperature up to 500°C, or to lower temperatures if limited by specimen cracking or fracturing. Ample documentation establishes the reliability of the property measurement methods and the accuracy of the results.



15701 **Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC).** McKenna, K.F.; Rej, D.J.; Tuszewski, M. (Los Alamos National Lab., NM (USA)). *Nuclear Fusion;* **23**: No. 10, 1319-1325(Oct 1983).

Zero-dimensional power balance calculations are performed for a quasi-static, purely Ohmically heated field-reversed configuration. Without compression, the constraint imposed by radial pressure balance limits the power input. Estimates of the energy loss from impurity line radiation as well as from classical and anomalous transport are given. Effects of cold puff gas injection are also investigated.

INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA)*. Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

• Corporate Author Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. **(Fiber Materials, Inc., Biddeford, ME (USA)).** Dec. 1983. 179p. NTIS File Number DE84004926. GPO Dep.

is indexed as:

Fiber Materials, Inc., Biddeford, ME (USA)

• Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Capps, W., *See* Lagedrost, J. F.
Lagedrost, J.F., Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R:US)
McKenna, K.F., Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J:US)
Rej, D.J., *See* McKenna, K.F.
Tuszewski, M., *See* McKenna, K.F.

• Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

SALT DEPOSITS
  Density
    Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
REVERSED-FIELD PINCH
  Energy Balance
    Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;AT)

• Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

AC06-76RL01830 **Fiber Materials, Inc., Biddeford, ME (USA)**
9:5785 BMI/ONWI-522

• Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under a File Number, that number is included in the availability statement. A File Number–Report Number Correlation is included for convenience.

BMI/ONWI-522	9:5785	NTIS, PC A09/MF A01. File Number DE84004926, Distribution Category MN-70

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Foreign Sources

CEA Centre d'Etudes de Saclay
GIF-sur Yvette Cedex, France

Fachinformationszentrum
Energie, Physik, Mathematik GmbH
Karlsruhe, Federal Republic of Germany

IEA Biomass Conversion Service
Dublin, Ireland

IEA Coal Research
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Plenum Publishing Corporation
New York, NY

University of Tennessee
Graduate School of Library and Information Sciences
Knoxville, TN

Communication concerning the editorial policy and content of *Energy Research Abstracts* should be addressed to the Editor, *Energy Research Abstracts,* Office of Scientific and Technical Information, Technical Information Center, P. O. Box 62, Oak Ridge, TN 37831.

SUBJECT CONTENTS (NUMERICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts.* The following listing includes the totality of the 40 first-level and 293 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope definitions and limitations is available as DOE/TIC-4584-R5 from NTIS for $9.50.

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ENERGY RESEARCH ABSTRACTS

01 COAL AND COAL PRODUCTS

47239 (ORNL—6078) Fossil Energy Program quarterly progress report for the period ending June 30, 1984. McNeese, L.E. (Oak Ridge National Lab., TN (USA)). Sep 1984. Contract AC05-84OR21400. 194p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE84017630.

This quarterly report covers the progress made during the period April 1 through June 30 for the Oak Ridge National Laboratory research and development projects that are carried out in support of the increased utilization of coal and other fossil fuels as sources of clean energy. These projects are supported by various parts of DOE including Fossil Energy, Basic Energy Sciences, the Electric Power Research Institute, and by the Tennessee Valley Authority through inter-agency agreement with DOE.

0104 Processing

REFER ALSO TO CITATION(S) 01040047315, 47317, 47319, 47321, 47321, 47322, 47336, 47337, 47338, 47342, 47343, 47350, 47361, 47406, 47407, 48171, 48205, 48210, 48293

47240 (DOE/CE—12158) Full-scale facility for dry cooling of coke. Final report. Seigel, L.G.; Graybrook, A.E. (United States Steel Corp., Monroeville, PA). 15 Apr 1984. Contract FC07-80ID12158. 151p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE84016341.

In 1977, United States Steel Corporation (USS) began developing a new method for dry cooling of coke to recover energy now wasted in the wet-quench process and to eliminate problems associated with air pollution. The method controls air pollution during both the pushing and cooling operations by confining the coke in essentially closed containers or passageways as it is transferred directly from the ovens to cooling chambers where it is cooled and delivered to a conveyor for transfer to the coke sizing station. After some small scale tests to demonstrate the feasibility of the system, USS entered into a cooperative agreement with the United States Department of Energy (DOE) to design, construct, and test a full-scale dry-coke cooling facility that could be operated at a working coke plant. This report describes the work done under that cooperative agreement.

47241 (DOE/ET/10069—T94) EDS coal liquefaction process development: Phase V. Quarterly technical progress report, January 1-March 31, 1984. (Exxon Research and Engineering Co., Florham Park, NJ (USA)). Jul 1984. Contract FC05-77ET10069. 56p. (FE—2893-136). NTIS (US Sales Only), PC A04/MF A01; 1; GPO Dep. File Number DE85001595.

This report is the twenty-first Quarterly Technical Progress Report for US Department of Energy Cooperative Agreement No. DE-FC05-77ET10069 for EDS Coal Liquefaction Process Development Phase V. A detailed comparison of RCLU, CLPP, and ECLP yields has been initiated. This study builds off previous yield modeling results, which found that RCLU, CLPP, and ECLP yields were generally consistent given the scatter of the data, although some differences were noted. These pilot unit yield differences have now been quantified, and operating/configurational differences which account for some of them have been identified. Preliminary yield comparison results after correcting for these known process differences between the pilot plants indicate that: RCLU and CLPP yields are generally consistent; ECLP's conversion is about 5 lb/100 lb DAF coal lower than RCLU/CLPP at comparable operating conditions; and work has been initiated to define the EDS slurry preheater feed system design (based on slurry distributor manifold guidelines and coking correlation predictions, which influence furnace pass control issues such as slurry flow measurement). EDS hydrotreated naphtha showed a low level of systemic toxicity to rats exposed to the vapor six hours per day, five days per week for thirteen weeks.

47242 (DOE/ET/10532—T15) Refining and upgrading of synfuels from coal and oil shales by advanced catalytic processes. Quarterly report, July-September 1983. Sullivan, R.F. (Chevron Research Co., Richmond, CA (USA)). Dec 1983. Contract AC22-76ET10532. 24p. (FE—2315-96). NTIS, PC A02/MF A01. File Number DE84004987.

A blend of 700°F- product from the Integrated Two-Stage Liquefaction (ITSL) Process was upgraded in pilot plant runs using Chevron's ICR 106 hydrotreating catalyst. The first run was a 5220-hr demonstration test in which the oil was hydrotreated at five different severities. Catalyst deactivation rate was very low. Detailed product properties are given in this report. The second run was a 500-hr test to prepare feed for a second-stage hydrocracker. 4 figures, 11 tables.

47243 (DOE/OR/03054—27) Utility distribution diagrams for the 6000-tpd SRC-I Demonstration Plant. Jul 1983. Contract AC05-78OR03054. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85001781.

In this report, the following utility requirements are compiled: (a) boiler feedwater and steam; (b) cooling, process and potable waters; (c) air, nitrogen, and fuels; (d) blowdown and condensate. These are compiled for each of the following three major plant areas: (1) SRC, area 12; (2) coke and liquid products, area 13; and (3) gas systems, area 15 and HPU unit. Requirements for the Utilities and Off-Site areas have not been developed at this time because Baseline information is outdated. Hydrogen purification requirements are included in the Gas Systems Area. Requirements for the Cryogenic Systems Area and the Naphtha Hydrotreater (NHT) Subarea were not significant enough to warrant separate compilation and development into distribution diagrams. However, the overall plant distribution network drawings will provide the requirements for these areas. The utility distribution diagrams show area battery limit pressures and temperatures, and the normal and maximum flow estimates for each utility. This information serves as the basis for sizing interface utilities networks. In addition, the drawings show unit-wide utility distribution within each area, which provides a better understanding of the intra-area requirements as well as a consistency check for the total area requirements.

47244 (DOE/OR/03054—72-Vol.1) 6000 TPD SRC-I Demonstration Plant, coke and liquid fuels naphtha hydrotreater: design baseline package. Volume 1. 25 Jul 1983. Contract AC05-78OR03054. 188p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85001622.

The 6000 tpsd Demonstration Plant is being designed and built for the purpose of demonstrating the technical feasibility, the environmental acceptability, and the economic feasibility of the Solvent Refined Coal (SRC-I) process. Raw naphtha will be distilled to the desired boiling range for the hydrotreater feedstock in the Naphtha Prefractionator. The overhead will be a pentane to 160°F TBP gasoline cut and sent to storage after condensing and cooling. The bottoms will be the feedstock to the hydrotreater unit and will be pumped into the Naphtha Hydrotreater Feed Surge Drum. The Naphtha Hydrotreater Feed Pump will deliver the feed at the required pressure to the reaction section. Hydrogen will be injected into the feed and the combined charge will be heated, the diolefins and dienes present in the feedstock saturated, and the sulfur-, nitrogen-, and oxygen-containing compounds hydrogenated. The liquid stream from the high pressure separator will be let down in pressure and flashed into the low pressure separator for phase-separation. The vapor stream will be sent to fuel gas and the liquid will be sent to the naphtha stabilizer for removal of butane and lighter components as an overhead which will be sent to fuel gas. The hydrotreated naphtha product will be recovered as a bottoms product and sent to storage after heat exchange and cooling. The overhead products from the low pressure separator and naphtha stabilizer will be combined and sent to a DEA unit for acid gas removal prior to injecting into the fuel system.

47245 **(DOE/OR/03054—72-Vol.2) 6000 tpd SRC-I Demonstration Plant coke and liquid fuels. Volume 2. Naphtha hydrotreater, design baseline package cost estimate.** Sep 1983. Contract AC05-78OR03054. 358p. NTIS, PC A16/MF A01; 1; GPO Dep. File Number DE85001623.

The cost estimate was developed using the Stearns-Roger Computer Aided Preliminary Estimating System (CAPES). CAPES uses basic process equipment design data, flow diagrams, plot plans, and other general project information to produce craft hours, labor costs, material quantities and material costs for each piece of equipment. These are then summarized by accounts (civil, structures and buildings, process equipment, electrical, instruction, paint and insulation) to provide total direct field costs. This estimate includes a contingency that reflects a 30 percent probability of overrun and an accuracy range at an 80 percent confidence level of 15 percent: (1) all costs and prices used in the CAPES estimate are first quarter, 1980. However, the estimate summary has been modified to reflect first quarter fiscal year 1982 costs; (2) construction labor is union, from these cities: Paducah, KY; Louisville, KY; Bowling Green, KY; and Evansville, IN; (3) the work week is 40 hours, with only casual premium pay included; and (4) electronic instrumentation is used, and is connected to the distributed control system.

47246 **(DOE/OR/03054—92) 6000 tpd SRC-I Demonstration Plant, SRC process and deashing water bath solidification system: design baseline package.** Jan 1984. Contract AC05-78OR03054. 149p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85001621.

Equipment diagrams, flowsheets, and specifications for a water bath solidification system are included in this report. The water bath extrusion system will solidify and pelletize molten streams of solvent refined coal produced in the SRC-I process unit. The final product will be rods or pencils with a maximum diameter of 1/2 in. with sufficient strength to minimize dusting and breakage. In order to process the various streams listed above, two extrusion units will be provided, each with a capacity of 46 tons per hour. Each unit is capable of 50% turn-down. The process will work as follows: (1) Molten streams will be received from the SRC stripper bottoms pump by one of three off-battery tanks (V-12801, 12802 or 12803). (2) The molten streams will then be pumped to one of four feed tanks. Enroute to these tanks, the streams will be cooled to about 460°F by an in-line steam generator cooler. (3) The feed will be further cooled in the agitated feed tanks to about 430°F. (4) The cooled, molten SRC will then be pumped by a variable speed rotary pump to an electrically heated extrusion header atop the solidification tank. Here it flows through specially designed nozzles protruding from the bottom of the header into the water where it is chilled into solid forms resembling a pencil. The pencils drop to the bottom of the solidification tank into a conveying system which lifts them out of the water and transports them to storage. Air from the SRC Product Drying Fan passes over the wet pencils to further dewater them during conveying. The Exhaust Fan aids in removing the excess humidity from the Extrusion Building. Figures.

47247 **(DOE/OR/03054—94) SRC-I technical report, July-December 1983.** Jun 1984. Contract AC05-78OR03054. 365p. NTIS, PC A16/MF A01; 1; GPO Dep. File Number DE85001630.

Results of supporting research programs for the SRC-I demonstration plant at Newman, Kentucky, have been entered individually into EDB and ERA (10 papers). (LTN)

47248 (DOE/OR/03054—94, pp 1-75) **Design impacts of operating SRC-I gas systems area equipment under maximum and minimum flow conditions.** Li, T.C. Jun 1984. NTIS, PC A16/MF A01. File Number TI85001630.

In SRC-I technical report, July-December 1983.

The Baseline Design (ICRC, 1982) for the gas systems area of the SRC-I Demonstration Plant was based only on normal flow conditions, specified in ICRC's Design Basis Memorandum (ICRC, 1981). However, following submission of the Baseline Design to the Department of Energy in 1982, all equipment in the gas systems area was re-evaluated to assess the design impact of operation at maximum and minimum flow conditions. The impact on the operating philosophy of each unit was also investigated. As the result of these evaluations, several additional tie lines were added for recycle, and some equipment was re-sized to accommodate the maximum and minimum flows. This article documents those cases that have been studied for Gas Systems minimum/maximum operations, and the design or operational changes that result. It is recognized that there may be other cases which should be considered prior to completion of the design. However, it is not believed that any significant cost increases will result from consideration of these other cases. The basis for evaluating the maximum and minimum flow rates and descriptions of controlling factors for both cases are presented in this report for each unit in the gas systems area. 8 references, 15 figures, 18 tables.

47249 (DOE/OR/03054—94, pp 77-156) **Liquid product characterization.** Skinner, R.W.; Stawasz, W.W.; Tiedge, W.F. (International Coal Refining Co., Allentown, PA; Air Products and Chemicals, Allentown, PA). Jun 1984. NTIS, PC A16/MF A01. File Number TI85001630.

In SRC-I technical report, July-December 1983.

Effective marketing of liquid products from the SRC-I Demonstration Plant will depend on the ability of these liquids to meet the marketing specifications of potential customers, and on the compatibility of these liquids with equivalent petroleum liquids in the customers' storage tanks. Samples representing the various liquid streams from run 235 at the Wilsonville Advanced Coal Liquefaction Facility and of ALCOA coker condensate were fractionated into light-, middle-, and heavy-oil cuts, which were then characterized. Composite samples of all of the distillate products expected to be generated at the SRC-I Demonstration Plant were prepared from these cuts and characterized by a series of analytical tests. An alternate-boiling-range middle oil was also prepared and analyzed. In addition, middle- and heavy-oil samples were blended at various ratios with comparable petroleum liquids and aged for up to 5 months at 110°F with exposure to air. The storage stability of the original and blended samples was then determined by subjecting the aged samples to a series of analytical tests. Finally, a composite sample of naphtha was fractionated into 25°F boiling-range cuts and analyzed to determine the distribution of dicyclics and heteroatomic species. 1 reference, 2 figures, 28 tables.

47250 (DOE/OR/03054—94, pp 157-182) **Coal dissolver design basis.** Harris, C.F.; Fazekas, A.D. (Air Products and Chemicals Inc., Allentown, PA). Jun 1984. NTIS, PC A16/MF A01. File Number TI85001630.

In SRC-I technical report, July-December 1983.

This report summarizes the coal dissolver design basis for the SRC-I project. The severity of the dissolver operating conditions was selected to maximize SRC recovery using the Kerr-McGee critical solvent deashing unit. Those conditions chosen were 2000 psia, 840°F, and a coal space rate of 38 lb coal/ft^3-h. Based on these operating conditions, a conservative yield structure was selected using a single dissolver. However, auxiliary equipment included in the process flow sheet retained the flexibility to operate with two dissolvers in series to effect higher product yields. If the gas holdup times are higher than expected, the two-in-series dissolver arrangement can be switched to the two-in-parallel system. A 2-ft-diam target plate at the dissolver entrance was selected as the optimum configuration for internal gas distribution, since the reaction is not mass transfer controlled. A batch solids withdrawal system was incorporated into the process design, and will be used on an as-needed basis. In case an increase in dissolver severity would be required to improve product yield or satisfy increased fuel gas requirements, the maximum operating pressure was increased from 2000 to 2200 psig. A monolithic wall was selected over the multiwall construction because of the lack of operating experience with a multiwall design at the SRC-I plant operating conditions. 16 references, 4 figures, 9 tables.

47251 (DOE/OR/03054—94, pp 183-199) **Coal slurry preparation design using 20- or 200-mesh coal.** Jun 1984. NTIS, PC A16/MF A01. File Number TI85001630.

In SRC-I technical report, July-December 1983.

Catalytic, Inc. conducted a study to determine the most flexible and efficient slurry piping system for the SRC-I Demonstration Plant that is capable of processing both 200- and 20-mesh coal, as well as allowing train capacity turndown to 50%. Critical velocities were calculated for d_{50}, d_{70}, and d/sub max/ particle sizes, and then compared with actual velocities from operating pipelines. It was determined that velocities based on d_{50} particle size were more in line with industrial experience. However, because operating pipelines are run on water slurry and the demonstration plant will be operated on oil slurry, it was deemed prudent to design the plant's slurry system at a critical velocity based on d_{70} particle size. On this basis, catalytic designed a system for 20-mesh coal, which was determined to be adaptable to 200-mesh coal, and which allowed a 50% turndown in capacity.

47252 (DOE/OR/03054—94, pp 201-219) **LC-finer catalyst testing.** Garg, D. (Air Products and Chemicals, Inc., Allentown, PA). Jun 1984. NTIS, PC A16/MF A01. File Number TI85001630.

In SRC-I technical report, July-December 1983.

During this final period of study, the activity and aging of Shell 324 Ni-Mo-Al catalyst in the hydroprocessing of heavy SRC was examined at 825°F. An SRC conversion of 54% occurred during the first 24 h of operation, while overall desulfurization, denitrogenation, and deoxygenation were 93, 60, and 76%, respectively. SRC conversion, oils and hydrocarbon gas production, overall denitrogenation and deoxygenation, hydrogen consumption, and first-order rate constant for SRC conversion decreased slightly during the initial 96 h of operation, (catalyst age = 59 weight units of SRC per weight unit catalyst), but decreased significantly thereafter. However, SRC sulfur content and overall desulfurization decreased gradually with time on stream. The decline in catalyst activity after 96 h, as reflected in these results, could have been partly due to upsets in PDU operation. Analysis of spent catalyst revealed a significant reduction in surface area and an almost total disappearance of pore structure. Furthermore, the spent catalyst showed heavy sodium deposition (2%), which was due to the presence of a high level of sodium in the feed. A mass balance around the system revealed that only minor portions of iron and titanium present in the feed SRC were deposited on the catalyst, whereas almost all of the sodium was retained by the catalyst. The reduction in surface area due to coke and metal deposition coupled with total loss of pore structure were the main reasons for the significant decline in catalyst activity. 2 references, 5 figures, 9 tables.

47253 (DOE/OR/03054—94, pp 223-275) **ICRC Fired Heater Test Program.** Thew, T.W.; Thorogood, R.M. Jun 1984. NTIS, PC A16/MF A01. File Number TI85001630.

In SRC-I technical report, July-December 1983.

The ICRC fired-heater test program conducted at Ft. Lewis in 1980 provided a comprehensive data base for the design of the demonstration plant fired heater. Some preliminary conclusions derive from these tests: (1) solvent-only base-line tests provided a very strong foundation to assess the accuracy of the instrumentation. Following the shutdowns to improve tube-wall temperature measurement techniques, these runs were repeated periodically throughout the program as a means of calibration and coke determination. We are highly confident in the accuracy of the data obtained; (2) slurry runs were completed over a broad range of slurry and gas rates in a matrix of experiments. Trends in both heat-transfer characteristics and pressure-drop phenomena clearly point toward time/temperature and shear rate dependence; (3) residence-time studies in the fired heater show clearly that slurry-phase residence time depends upon gas rate; (4) no coking was observed in this test series. This is consistent with the assumption that maintaining inside wall temperature below 850°F minimizes coke formation; and (5) pressure drop increases as the coal particle size decreases. No attempt has been made to reduce and correlate the data. This program was completed in direct support of the demonstration plant design effort. 2 references, 30 figures, 6 tables.

47254 (DOE/OR/03054—94, pp 277-300) **High-temperature slurry mix test.** Thew, T.W. Jun 1984. NTIS, PC A16/MF A01. File Number TI85001630.

In SRC-I technical report, July-December 1983.

Results of high-temperature, slurry-mix studies revealed that 38.5 wt % slurry from feed coal and process solvent can be prepared successfully at temperatures ranging from 350 to 420°F. Although all data indicate an increase in slurry viscosity with increase in temperature over this range, the measured values of 30 to 100 cP are consistent with other sources of slurry viscosity data and do not hinder design efforts. Results of these studies not only showed that equipment design should not be significantly affected by an increase in the slurry mixing temperature, but also identified potential thermal efficiency improvements. A special study examined the effects of both residence time and coal concentration on slurry mixing (at a blend tank temperature of 350°F), as well as fired heater performance. Residence time seemed less important than anticipated over the 3- to 25-min range, but any effect may be enhanced at temperatures greater than 350°F, as the laboratory rheology study concludes. Increases in coal concentration revealed a trend toward upstream displacement of the gel region, as well as greater overall pressure drops. 10 figures, 4 tables.

47255 (DOE/OR/03054—94, pp 301-317) **Coal feed slurry rheology.** Thew, T.W. Jun 1984. NTIS, PC A16/MF A01. File Number TI85001630.

In SRC-I technical report, July-December 1983.

Rheological characterization of coal feed slurry was undertaken in conjunction with SRC-I slurry mix tests at the Ft. Lewis SRC Pilot Plant in January 1981. Results show that the shear-dependent fluid behaves like a Bingham plastic, as reflected by a linear dependence of shear stress upon shear rate and a finite (>0) yield stress at zero shear. Viscosities increased with increasing temperature over the range of 285 to 420°F, but were independent of residence time over the range of 14 to 41 minutes. Shear rates spanned a range of 9.3 to 186 sec^{-1}, and though non-Newtonian behavior was very evident in this interval, extrapolation to higher shear rates indicates coal feed slurry is essentially Newtonian. These studies indicate that, for design purposes, a viscosity of 95 cP at temperatures up to 420°F should be specified for the coal feed slurry. 11 figures, 2 tables.

47256 (DOE/OR/03054—117) **Existing technology transfer report: second-stage support.** Garg, D. (Air Products and Chemicals, Inc., Allentown, PA (USA)). Jun 1984. Contract AC05-78OR03054. 112p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85001637.

Since the economics of SRC hydrotreating depends greatly on both catalyst life and the type of reactor system, an extensive research program was initiated to address several issues pertaining to the design and operation of a large-scale SRC hydrotreater, including catalyst activity and aging, reactor design, and catalyst replacement rate. The objectives of this program were to (1) study the hydrotreating of SRC in an upflow fixed-bed reactor, (2) study the hydrotreating of SRC in a downflow fixed-bed reactor, (3) compare the performances of upflow and downflow fixed-bed reactors, (4) study the fluid dynamics of upflow and downflow fixed-bed reactors, and (5) study the activity, selectivity, and aging of a specially prepared monolithic catalyst for hydroprocessing SRC. APCI focused its work on the fixed-bed reactor, since it was conventionally used in hydrotreating petroleum products. The active materials used to prepare the catalysts were metals selected from Groups VI and VIII of the periodic table. Catalysts such as cobalt-molybdenum, nickel-molybdenum, and nickel-tungsten supported on alumina were tested. These catalysts are usually poisoned by the ash present in coal-derived materials. Therefore, another aspect of the internally funded program was to develop an ash-tolerant catalyst to successfully hydrotreat SRC. An ash-tolerant catalyst was prepared by supporting the catalytic metals on a honeycomb (monolithic) structure. The honeycomb structure was thought to be extremely ash resistant because of its high geometric surface area per unit volume and large open cross-sectional area. Furthermore, liquid flow in the channels of the honeycomb was expected to be laminar, with little or no induced turbulence due to form friction. Activity of the so-called ash-tolerant honeycomb (monolithic) catalyst was measured for SRC hydrotreating in a catalytic fixed-bed reactor, using both upflow and downflow operating modes. 2 references, 14 figures, 6 tables.

47257 **(DOE/OR/03054—118) Existing technology transfer report: filtration and deashing technology.** Mehta, M.V. (Air Products and Chemicals, Inc., Allentown, PA (USA)). Jun 1984. Contract AC05-78OR03054. 200p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85001638.

The primary objective of the solid/liquid separation evaluation program was to determine liquid (SRC) recovery and solid removal efficiency for each of the promising techniques considered for the SCR-I plant design. The selected techniques must meet the established product specification, which restricts the amounts of ash present in the SRC to 0.16 wt %. Further, the selection must be made on its own economic merits, taking into account the initial capital cost and the operating cost. The selection must be based on techniques that have been demonstrated using the SRC-I process materials and that can be scaled up to the requirements of the demonstration plant based on sound fundamentals. To fulfill the above objectives, several promising solid/liquid separation techniques were tested at the Wilsonville and Ft. Lewis pilot plants. Some small-scale tests were also conducted at the vendor's facilities to generate preliminary process flow sheets and material balances, from which economic evaluations were carried out. This report presents a summary of the solid/liquid separation technologies considered, their operation, evaluation, and tests, as well as any pertinent results. It briefly describes subsequent tasks and studies undertaken to support the SRC-I Demonstration Plant design for the solid/liquid separation area.

47258 **(DOE/OR/03054—119) Existing technology transfer reports. Summary.** Schweighardt, F.K. (Air Products and Chemicals, Inc., Allentown, PA (USA)). Jun 1984. Contract AC05-78OR03054. 71p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85001639.

From 1974 to 1980, Air Products and Chemicals, Inc. (APCI) conducted a broad spectrum of internal research projects on coal, coal liquefaction processing, and coal liquids analysis. The sum of all of these projects is reported to the United States Department of Energy (DOE) by a set of five Existing Technology Transfer Reports under the following titles: (1) Liquefaction Process and Product Studies, DOE/OR/03054-109; (2) Filtration and Deashing Technology, DOE/OR/03054-118; (3) Dissolver Cold-Flow Modelling, DOE/OR/03054-108; (4) Second-Stage Support, DOE/OR/03054-117; and (5) Analytical Capabilities, DOE/OR/03054-116. This summary report provides an overview of the five Existing Technology Transfer Reports by highlighting the program objectives/results and listing the documents in which the original experimental data are contained. These documents are presented as either an attached appendix or as a file of raw data maintained by the US DOE and the International Coal Refining Company (ICRC).

47259 **(DOE/OR/03054—123) SRC-I Demonstration Plant project. Analysis of cost growth.** Brestovansky, G.F.; Kuhns, A.R. Jul 1984. Contract AC05-78OR03054. 297p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE85001631.

As design has progressed, the cost to build the SRC-I Demonstration Plant has grown considerably, a not uncommon occurrence for pioneer plants. At DOE's request, ICRC conducted a cost-growth study to document in detail the demonstration-plant cost growth that occurred between Phase 0 (July 1979) and the Revised Baseline (June 1984) and to analyze the cost growth by using a correlation developed by the Rand Corporation. The Rand correlation predicts the estimate at completion from a current estimate and the degree of plant complexity that exists for that current estimate. The results of the study indicated that the largest cost growth in the demonstration plant occurred in the utilities and offsites area and the engineering and program management portions of the estimate. Application of the Rand correlation for cost growth to each of six estimates prepared during the design phase should theoretically have resulted in the convergence of these estimates toward a single estimated actual cost at completion. Although it would be possible to restructure some of the estimates and choose parameter values so that a reasonable convergence of the estimates toward a single value would be achieved, the actual parameter values chosen, representing ICRC' best judgment, did not lead to estimate convergence.

47260 **(DOE/OR/03054—T19) Process R and D Plan: SRC-I Demonstration Plant.** Dec 1981. Contract AC05-78OR03054. 197p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85001618.

This Process R and D Plan has been compiled to justify the need for programs developed to support the SRC-I Demonstration Plant Project. The importance of the Wilsonville Technical Support Plan and other DOE-funded R and D programs is addressed. More specifically, the plan: (1) identifies technology gaps and proposes specific R and D programs to ensure the technical viability and environmental acceptability of the SRC-I Demonstration Plant; (2) presents management information required to implement laboratory and pilot plant programs; (3) seeks DOE approval for the technical emphasis and direction of R and D programs; and (4) establishes R and D budget levels required to implement the plan. Depending upon its bearing on the design, construction, and/or operation of the demonstration plant, each program is classified into one or more of the following: direct design support; design verification; operations support; evaluation of process improvement; and general technical support.

47261 **(DOE/OR/03054—T20-Vol.1) Utilities and offsites design baseline. Outside Battery Limits Facility 6000 tpd SRC-I Demonstration Plant. Volume 1.** 25 May 1984. Contract AC05-78OR03054. 627p. NTIS, PC A99/MF A01; 1; GPO Dep. File Number DE85000248.

As part of the overall Solvent Refined Coal (SRC-1) project baseline being prepared by International Coal Refining Company (ICRC), the RUST Engineering Company is providing necessary input for the Outside Battery Limits (OSBL) Facilities. The project baseline is comprised of: design baseline - technical definition of work; schedule baseline - detailed and management level 1 schedules; and cost baseline - estimates and cost/manpower plan. The design baseline (technical definition) for the OSBL Facilities has been completed and is presented in Volumes I, II, III, IV, V and VI. The OSBL technical definition is based on, and compatible with, the ICRC defined statement of work, design basis memorandum, master project procedures, process and mechanical design criteria, and baseline guidance documents. The design basis memorandum is included in Paragraph 1.3 of Volume I. The baseline design data is presented in 6 volumes. Volume I contains the introduction section and utility systems data through steam and feedwater. Volume II continues with utility systems data through fuel system, and contains the interconnecting systems and utility system integration information. Volume III contains the offsites data through water and waste treatment. Volume IV continues with offsites data, including site development and buildings, and contains raw materials and product handling and storage information. Volume V contains wastewater treatment and solid wastes landfill systems developed by Catalytic, Inc. to supplement the information contained in Volume III. Volume VI contains proprietary information of Resources Conservation Company related to the evaporator/crystallizer system of the wastewater treatment area.

47262 **(DOE/OR/03054—T20-Vol.2) Utilities and offsites design baseline. Outside Battery Limits Facility 6000 tpd SRC-I Demonstration Plant. Volume 2.** 25 May 1984. Contract AC05-78OR03054. 298p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE85000247.

Volume 2 contains flowsheets and equipment specifications for the following parts of the plant: cooling water systems, process water supply, potable water supply, nitrogen system, compressed air system, flares, incinerators, fuels and interconnecting systems (pipes). The instrumentation requirements are included. (LTN)

47263 **(DOE/OR/03054—T20-Vol.3) Utilities and offsite design baseline. Outside Battery Limits Facility 6000 tpd SRC-I Demonstration Plant. Volume 3.** 25 May 1984. Contract AC05-78OR03054. 280p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE85000250.

Volume III contains information on: water treatment (potable, process and waste water) and waste solids handling. (LTN)

47264 (DOE/OR/03054—T20-Vol.4) Utilities and off-sites design baseline. Outside Battery Limits Facility 6000 tpd SRC-I Demonstration Plant. Volume 4. 25 May 1984. Contract AC05-78OR03054. 472p. NTIS, PC A20/MF A01; 1; GPO Dep. File Number DE85000201.

Volume IV contains site development and preparation information on: railways, roads, fences, river structures, buildings, raw materials and product handling and storage facilities including coal preparation facilities. (LTN)

47265 (DOE/OR/03054—T20-Vol.5) Utilities and off-sites design baseline. Outside Battery Limits Facility 6000 tpd SRC-I Demonstration Plant. Volume 5. (Catalytic, Inc., Philadelphia, PA (USA)). 1984. Contract AC05-78OR03054. 508p. NTIS, PC A22/MF A01; 1; GPO Dep. File Number DE85000249.

The wastewater treatment facilities for the SRC-1 demonstration plant in Newman, Kentucky were designed and cost estimated by the Rust Engineering Company in October, 1981 (revised March, 1982). The basis of design has changed since that original, or baseline, estimate. The new treatment scheme differs in two major ways. First, the main process waste stream in pre-treated in a solvent extraction procedure to remove phenol. Second, the final effluent will be discharged to the Green River, rather than recycled to the plant. In addition, laboratory treatability testing conducted subsequent to the Rust baseline report has changed the sizing criteria for various unit processes. The treatment facilities are subdivided into five areas. These divisions are process related, and are defined as primary, secondary, tertiary, sludge and landfill. For the most part, the equipment in a given process area is grouped together. That is, the divisions are also geographical. Any exceptions are due either to the SRC plant layout or to hydraulic considerations. The plant is designed to treat not only the normal process flows, but also all stormwater which has become contaminated. Either installed spares or parallel treatment trains are provided for virtually all equipment. All pumps are sized for the maximum hydraulic conditions. Volumes 1 and 2 contain the design information, such as process descriptions, drawings, and equipment data sheets. Volume 3 contains the capital and operating cost estimates.

47266 (DOE/PC/50001—28) Short contact time liquefaction of subbituminous coal. Jul 1984. Contract AC22-82PC50001. 64p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85001160.

This report describes a series of continuous unit studies determining how pyrite addition, as well as other variables (including solvent quality, slurry recycle, temperature, residence time), affect the short contact time liquefaction of subbituminous coal. Dissolution of low-rank coal is much more strongly affected by pyrite addition than by solvent quality. Mild hydrotreatment of an SRC I solvent provided a solvent which increased conversion only slightly over that achieved with the original SRC I solvent. Addition of pyrite or pyrrhotite, however, resulted in a significant improvement in conversion. The low quality solvent was SRC I solvent while the high quality solvent was from the Lummus Integrated Two-Stage Liquefaction Process. Essentially identical conversions were obtained with the high quality and low quality solvents. Pyrite brought about the same significant improvement in conversion in each of the solvents. Although use of a lower level of a higher quality catalyst (CoMo/Al_2O_3) increased hydrogenation and increased conversion of SRC to distillate more effectively than pyrite, the pyrite was more effective in decreasing the insoluble organic matter yield. Conversion was also increased by partial slurry recycle; i.e., by recycling a fraction of the dissolver effluent (containing SRC, insoluble organic matter and mineral matter) mixed with an equal amount of distillate in place of all distillate solvent of the normal short contact time SRC I process. Over the ranges investigated, conversions increased with increasing temperature or residence time. These increasing conversions were generally accompanied by increasing hydrogen consumption and/or hydrocarbon gas make.

47267 (DOE/PC/50001—32) Liquefaction of low rank coals with slurry catalysts. Part I. Comparison of coals. Jul 1984. Contract AC22-82PC50001. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85001162.

One of the most significant achievements over the last several years in development of the SRC-II process was extension of its applicability to include low-rank coals. With addition of moderate amounts of pyrite, operation was trouble-free and oil yields exceeding those obtainable with higher rank feedstocks were obtained. In addition, product sulfur level was lower due to the relatively low sulfur content of the lower rank coals. Total oil yield generally decreased as rank decreased from high volatile C bituminous to lignite. An exception to this was the oil yield from Texas lignite, which was the highest of those from the seven coals evaluated. Oil yields from all of these coals were greater than those generally obtained from higher rank bituminous coals, however. There was no apparent correlation between rank and conversion to pyridine-soluble material. The distillate products fom these coals were similar in composition, but the hydrogen and heteroatom levels were related to those in the feed coal. 2 figures, 6 tables.

47268 (DOE/PC/50001—33) Liquefaction of low rank coals with slurry catalysts. Part II. Comparison of catalysts. Jul 1984. Contract AC22-82PC50001. 67p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85001161.

One of the most significant achievements over the last several years in development of the SRC-II process was extension of its applicability to include low rank coals. With addition of moderate amounts of pyrite, operation was trouble free and oil yields exceeding those obtainable with higher rank feedstocks were obtained. In addition, product sulfur level was lower due to the relatively low sulfur content of the lower rank coals. Pyrite was the first catalyst tried and numerous other materials were investigated in an attempt to find a better additive. These included emulsions (Mo, Fe and Ni/Mo), ferric oxide alone and doped with Mo, iron on Al_2O_3 and several sources of H_2S. None were found to be more effective, and on the basis of cost, pyrite is still preferred. Additive levels much lower than those used initially were found to be sufficient for smooth operation. As little as 0.6 wt % FeS_2, based on MF Belle Ayr coal, provided satisfactory operation, which makes use of low rank coals in the SRC II process even more attractive. 8 figures, 6 tables.

47269 (DOE/PC/50001—34) Liquefaction of low rank coals with slurry catalysts. Part III. Variable effects. Jul 1984. Contract AC22-82PC50001. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85001163.

One of the most significant achievements over the last several years in development of the SRC II process was extension of its applicability to include low-rank coals. With addition of moderate amounts of pyrite, operation was trouble-free and oil yields exceeding those obtainable with higher rank feedstocks were achieved. In addition, product sulfur level was lower due to the relatively low sulfur content of the lower rank coals. The effects of run conditions with low-rank coals and added pyrite are discussed in this report. The ratio of distillate product to hydrocarbon gas produced (or hydrogen consumed) is increased by lowering the reaction temperature over the range of 450°C (842°F) to 420°C (788°F). The oil production rate is also decreased, so there is an economic tradeoff between reactor vessel size and hydrogen production requirements. Raising the temperature above 450°C (842°F) at 1.0 hour residence time is detrimental, resulting in increased gas make, reduced oil yield and less conversion to pyridine-soluble components. Operation and yields at 450°C (842°F) and 1.0 hour residence time are improved by increasing the pressure to 2250 from 1800 psig. Operation is not possible at 1600 psig. 5 figures, 7 tables.

47270 (DOE/PC/50001—35) Effects of coal beneficiation and solvent quality on short contact time liquefaction of bituminous coal. Jul 1984. Contract AC22-82PC50001. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85001164.

A series of beneficiated coals (Illinois No. 6) from the Burning Star Mine No. 2 were evaluated in a bench scale continuous coal liquefaction unit. These included run-of-mine (22% ash), coal conventionally cleaned at the mine site preparation plant (11% ash), coal cleaned by oil agglomeration (10% ash), and deep-cleaned coal (3% ash). The oil agglomeration technique was of particular interest as it was known to preferentially leave pyrite in the cleaned coal. In short contact time liquefaction, the primary measure of reactivity is conversion to soluble material. In this study, it was found that conversion to soluble material was not correlated with iron content but rather was related to depth of cleaning. The two highest iron content coals, the run-of-mine and oil-agglomerated, exhibited the lowest conversions. Conversion was maximized with the deep-cleaned coal which had the lowest iron content. The oil-agglomerated and conventionally-cleaned coal were of similar ash content; the conventionally-cleaned coal contained less iron but showed an increased conversion compared to the oil-agglomerated coal. In contract to the conversion results, there was a strong correlation between iron in the feed coal and distillate yield. For two-stage processing, quality of the SRC is also of importance. Conversion of preasphaltenes to more soluble materials was maximized with the high iron coals and was minimized with the deep-cleaned coal. More favorable results were obtained with the Lummus solvent but differences between the two solvents were small. 27 references, 4 figures, 6 tables.

47271 **(DOE/PC/50033—T1) Syn-fuel reciprocating charge pump improvement program. Quarterly technical project report, January-March 1984.** Malsbury, R.G. Jul 1984. Contract AC22-82PC50033. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84015439.

The main efforts during the first quarter of 1984 were to conduct Phase II laboratory tests in the clear water test loop. During Phase II laboratory testing the reciprocating slurry pump was operated with liquid leg separation seals, floating piston type separation seals, and a diaphragm type separation seal. These tests were all conducted on a clear water test loop. No slurry was involved in this testing. The purpose of these tests was to: (1) install and debug the Ingersoll-Rand Model 3V3 pump skid package; (2) operate and debug the clear water test loop; (3) conduct performance test with liquid leg, floating piston, and diaphragm type seals; (4) determine operational problems with these seals; (5) determine operation problems with the Seal Buffer Volume Control Systems; (6) simulate component failure, especially packing failure, and determine its impact on the seals and their buffer control operation; and (7) develop the pump to the point such that field trials will be interrupted only by slurry related problems. Additional efforts during this period were focused on preparing for the installation of the reciprocating pump in a sand water test loop.

47272 **(DOE/PC/50046—11) Corrosion in fractionation towers. Report for the Technical Data Analysis Program.** Aug 1984. Contract AC22-82PC50046. 116p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE84017339.

This report reviews the corrosion experience in fractionation towers at both the Process Development Unit P-99 at Gulf Research and Development Company's Harmarville (Pa.) facility and the Ft. Lewis Pilot Plant at Tacoma, Washington. At both these units, evidence indicates chloride containing feed to the towers as the source of corrosion. The results of desalter tests conducted by Petreco Division of Petrolite Corporation on high chloride containing Ft. Lewis atmospheric tower feed samples are also reported. In addition, features to reduce corrosion that were to be incorporated into the planned SRC-II Demonstration Plant are described. The report from Fort Lewis is attached as an appendix and has been entered individually into EDB and ERA.

47273 (DOE/PC/50046—11, pp vp, Paper 1) **Stress corrosion cracking in the reaction area and corrosion in the fractionation area of the Fort Lewis SRC Pilot Plant.** Canfield, D.R. (Pittsburg and Midway Coal Mining Co., Fort Lewis, WA). Aug 1984. NTIS, PC A06/MF A01. File Number TI84017339.

In Corrosion in fractionation towers. Report for the Technical Data Analysis Program.

Stress corrosion cracking in austenitic stainless steel has occurred in relatively few locations in over five years of operation. Chloride stress corrosion cracking has been primarily limited to dead-legs such as pipe nipples or safety valves which trap salts and provide the environment for cracking. In addition to chloride stress corrosion cracking, there has been some polythionic stress corrosion cracking which is primarily associated with the 304 stainless steel cladding in three flash vessels located in the reaction area. These vessels, however, were also subjected to excessive thermal treatments because of fabrication problems. These thermal treatments produced a sensitized type 304 stainless steel cladding which made it susceptible to intergranular attack by polythionic acid. Although polythionic stress corrosion cracking has been a source of concern, its presence has been eliminated by using type 347 stainless steel weld overlay in place of the sensitized 304 stainless steel cladding. The fractionation area has experienced severe corrosion since early plant start-up. Corrosion has been most severe in the Wash Solvent Column where corrosion rates have been as high as 230-240 mils per year for 316 stainless steel. A review of plant experience has shown that the column operating conditions (distillation specifications) and possibly product yield structure strongly affect the corrosion pattern and the location of maximum corrosion rate. Laboratory analysis of oils show that periods of high corrosion are associated with relatively high concentrations of chlorides. Laboratory studies also show a dramatic increase in corrosion rates by the addition of ammonium chloride and a dramatic decrease by water washing the as received feedstock.

47274 **(DOE/PC/50046—13) Area 3, SRC-II coal slurry preheater studies report for the technical data analysis program.** Aug 1984. Contract AC22-82PC50046. 204p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE85001355.

This report reviews the raw data gathered from the Preheater B test runs at Ft. Lewis, and also the Preheater B results presented in the Solvent Refined Coal (SRC) Process Final Report, Volumes 1 and 2 of Slurry Preheater Design, SRC-II Process and the Ft. Lewis Slurry Preheater Data Analysis, 1 1/2 Inch Coil by Gulf Science and Technology Corporation of Pittsburgh, Pennsylvania. attempts were made to correlate several variables not previously considered with slurry viscosity and thermal conductivity. Only partial success was realized. However, in the process of attempting to correlate these variables an understanding of why some variables could not be correlated was achieved. An attempt was also made, using multiple linear regression, to correlate coal slurry viscosity and thermal conductivity with several independent variables among which were temperature, coal concentration, total solids, coal type, slurry residence time, shear rate, and unit size. The final correlations included some, but not all, of these independent variables. This report is not a stand alone document and should be considered a supplement to work already done. It should be read in conjunction with the reports referenced above.

47275 **(DOE/PC/50046—14) Fractionation systems: coking potential in fired heaters.** Aug 1984. Contract AC22-82PC50046. 97p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE84017034.

This report reviews all the work done by Solvent Refined Coal International in attempting to quantify the coking tendencies of feedstocks to the atmospheric tower preheater and the vacuum tower preheater of the proposed 6000 TPD (coal feed) SRC-II Demonstration Plant at Morgantown, West Virginia. Data from laboratory batch tests and also continuous runs on a small bench scale unit were examined. In addition, those features incorporated into the design of the fractionation section of the Demonstration Plant to minimize coking in preheaters are described.

47276 **(DOE/PC/60019—3) Two-stage process for conversion of synthesis gas to high quality transportation fuels. Quarterly report, 1 January 1984-31 March 1984.** Kuo, J.C.W. May 1984. Contract AC22-83PC60019. 45p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85001381.

This quarter has seen the shakedown and startup of both the two-stage pilot plant and the tall hot-flow non-reacting bubble-column (5.1 cm ID x 9.1 m height). Evaluation of a new Fischer-Tropsch catalyst was initiated in the pilot plant, while the hot-flow model was used to study the effects of ditributor type, temperature, pressure, and static liquid height on gas holdup. Scoping hydrodynamic studies were done, using the short hot-flow bubble-column, and a short run was performed using a small bubble-column reactor (Unit CT-225) to determine the effect of pretreatment on the new F-T catalyst. During the run, a single orifice was successfully used as a gas distributor for the first time. 4 references, 19 figures.

47277 (DOE/PC/60039—3) **Phase behavior of coal fluids: data for correlation development. Report for the period February 1, 1984-July 31, 1984.** Robinson, R.L. Jr. (Oklahoma State Univ., Stillwater (USA). School of Chemical Engineering). 1984. Contract FG22-83PC60039. 18p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84016520.

The new solubility apparatus is in operation and functioning up to expectations. New data have been obtained on CO_2 solubilities in benzene, trans-Decalin and cyclohexane. The data are described well by the Soave equation of state using two binary interaction parameters for each system. 15 references, 5 figures, 4 tables.

47278 (DOE/PC/60048—3) **Advanced direct coal liquefaction. Quarterly technical progress report No. 3, March 1984-May 1984.** Paranjape, A.S. 31 Jul 1984. Contract AC22-83PC60048. 74p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE84016496.

During the March-May period, four Bench-Scale coal liquefaction runs were completed. All four runs utilized a common two-stage process configuration. In this particular process configuration, LDAR, the light fraction of the ash-free resid, was first hydrotreated in the catalytic stage prior to its recycle to the thermal stage (coal dissolution stage). The heavy fraction of the ash-free resid, DAR, was directly recycled to the thermal stage without any intermediate processing step. Run 40, made with Wyoming subbituminous coal, was completed as part of Task 3 runs using 4 wt % iron oxide (MF coal basis) as a disposable catalyst. In addition, during Run 40, the use of dimethyl-disulfide (DMDS) was tested for the first time as a source of H_2S to be used in conjunction with the iron oxide. Two other Bench-Scale Runs (Nos. 41 and 42) were made with Illinois No. 6 bituminous coal under Task 2. Last bench-scale run of this contract, Run 43, was made to produce vacuum bottoms which will allow testing of the CSD secondary extraction equipment. Results indicate that by increasing the iron oxide concentration to 4.0 wt % (MF coal basis) without simultaneous increasing in the hydrogen sulfide content of the gaseous phase, the coal conversion and distillate yield were reduced. The addition of dimethyl-disulfide to the coal slurry resulted in an increase in hydrogen sulfide concentration in the gas phase to a level that is assumed to promote partial conversion of iron from the oxide to the sulfide form. The process response to the DMDS addition was immediate. 4 figures, 25 tables.

47279 (DOE/PC/60781—4) **Novel catalytic methods for heteroatom removal in coal liquids upgrading. Quarterly report No. 4, June 1, 1984-August 31, 1984.** Laine, R.M.; Hirschon, A.S.; Wilson, R.B. Jr. (SRI International, Menlo Park, CA (USA)). Aug 1984. Contract FG22-83PC60781. 28p. NTIS, PC A03/MF A01; GPO Dep. File Number DE84017055.

The purpose of this work is to optimize the conditions for the second stage of the coal liquefaction scheme: the catalytic removal of sulfur, nitrogen, and oxygen (written in order of increasing difficulty). The removal of oxygen is important to increase the fuel value of the coal liquid, whereas the removal of nitrogen and sulfur is important for two reasons: (1) nitrogen and sulfur are a source of pollution and (2) they will poison reforming catalysts used to further upgrade coal liquids. Nitrogen and oxygen are the most difficult to remove and require the most consumption of hydrogen. The ultimate goal of this work is the removal of the heteroatoms with the minimum amount of hydrogen and with the lowest possible temperatures and pressures. Our results show that both hydrogen sulfide and trifluoroacetic acid aid in the HDN process. Although the HDN enhancement resulting from the addition of trifluoroacetic acid is most likely due to its acidic properties, it is difficult at this time to determine at what step in the HDN process the acceleration occurs. Furthermore, we cannot determine at this time if the enhancement of H_2S occurs because of its interaction with the catalyst, its acidic or its nucleophilic properties, or a combination of these effects. The appendix has been entered separately into EDB and ERA.

47280 (DOE/PC/60781—4, pp 10p, Paper 1) **Regular coal structure and conversion severity.** Ross, D.S.; Laine, R.M.; Green, T.K.; Hirschon, A.S.; Hum, G.P. Aug 1984. NTIS, PC A03/MF A01. File Number TI84017055. Contract AC22-81PC40785.

In Novel catalytic methods for heteroatom removal in coal liquids upgrading. Quarterly report No. 4, June 1, 1984-August 31, 1984.

We describe here two aqueous conversions in H_2O and D_2O, and a conversion run in tetralin. The aqueous conversions were run at initial acidities of pH 7 and pD 13, and provided conversions (toluene solubility) of 29 and 60%, respectively. The tetralin run afforded a 40% conversion yield. The toluene-soluble fractions were subjected to separation and analysis: The chromatograms were all virtually identical. The similarity in product profile spans not only a range of conversion from 29 to 60%, but also a change in medium. We also explored the effects of the addition of H_2S on tetralin/H_2 conversions (THF solubility) of Wyodak 2. The coal liquids from 44, 54 and 67% conversion are remarkably similar in product envelopes and weight average molecular weights. Also, the volatility curves were the same. In a study of the conversions of several coals in a donor solvent with increasing conversion severity (that term referring to conversion times and temperatures), Whitehurst et al found that the structure of all product fractions changed with increased severity, showing increased aromaticity, increased degrees of condensation, and accordant decreased H/C ratios. Thus, increasing thermolytic conditions not surprisingly favored thermal degradation, including dehydrogenation and coupling reactions. A model that can reconcile these differences is suggested. First, increased condensation and aromatization are an expected result of increased conversion times and/or temperatures. Free radical chain degradations are anticipated at conversion conditions, which reflect what we term thermal severity. Under our conditions of increasing reduction severity, increasingly potent conversion chemistry operates to break bonds. However, the polymer structure undergoing the degradation, on the basis of the constant product composition, must be a somewhat regularly structured organic matrix.

47281 (DOE/PC/60784—T2) **Rate of coal hydroliquefaction correlation to coal structure. Quarterly progress report, January-March 1984.** Baldwin, R.M. Jul 1984. Contract FG22-83PC60784. 19p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84016498.

A suite of coals from the Exxon Sample Library is being liquefied in a batch stirred autoclave reactor. The rate of conversion of coal to pentane-solubles, benzene-solubles, and THF-solubles is being determined for each coal, and global rate models for each product solubility classification are being derived. Rate and extent of conversion of coal are being correlated to physical and chemical parameters of the parent coal. This report presents the results for liquefaction of two coals from the Exxon collection at three different temperatures. Rate modeling and calculation of an overall activation energy are described in terms of lumped parameter kinetics. Initial data collection by pyrolysis/mass spectrometry is described. 1 figure, 11 tables.

47282 (DOE/PETC/QTR—84/3) **Quarterly technical progress report for the period ending June 30, 1984.** Oct 1984. 149p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85001441.

The Magnetohydrodynamics Program (Component Development and Integration Facility) in Butte, Montana, continued its site preparation for the TRW first-stage combustor installation. In the area of flue gas cleanup, our in-house research program is continuing its investigation into the causes of sorbent attrition in PETC's fluidized-bed copper oxide process for simultaneous SO_2/NO/sub x/ removal. Interwoven with these tests is a series of spray dryer/electrostatic precipitator tests that are being conducted with the cooperation of Wheelabrator-Frye, Inc. This test series was completed this quarter, and the data show that when using a Kentucky coal, Wheelabrator-Frye's electrostatic precipitator provides excellent particulate control efficiency while using a spray dryer for sulfur dioxide removal. A unique project at Carnegie-Mellon University is looking at the concept of integrated environmental control for coal-fired power plants making use of precombustion, combustion, and postcombustion control, including systems for the simultaneous removal of more than one pollutant. The objective of this research is to develop a computer model and assessment for integrated environmental control systems that utilize conventional or advanced systems. The Liquid Phase Methanol Project Development Unit in LaPorte, Texas, was restarted after a successful shakedown run was completed. PETC has recently begun an in-house research project aimed at exploring the basic chemistry of liquefying coal in the presence of water under supercritical conditions. In the Alternative Fuels Technology Program, the Gulf Research and Development Company has completed the preliminary testing phase of its erosion test loop. Their results indicate that when pumping a coal-water slurry fuel through a flow loop, the erosion rate increases as velocity increases, suggesting a well-defined relationship between these two parameters.

47283 (DOE/RL/01830—T28) Development of an advanced water-gas shift conversion system. Quarterly progress report, May-July 1984. Sealock, L.J. Jr.; Elliott, D.C.; Butner, R.S. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1984. Contract AC06-76RL01830. 27p. NTIS, PC A03/MF A01; GPO Dep. File Number DE84017563.

The objective of current work is to conduct research and development to investigate the use of an aqueous catalyst system for conducting the water-gas shift reaction. This objective will be accomplished by performing continuous laboratory scale experimentation designed to prove the technical concept. The initial phase of the project will provide the data base required to establish operating parameters as well as document the feasibility and economic potential of the concept. A continuous flow experimental apparatus will be designed and fabricated which will allow simulated raw coal gasification product gas to be contacted with an aqueous catalyst system at a range of temperatures (200 to 400°C) and pressures (500 to 3000 psig). Kinetic information for the water-gas shift reaction will be developed with attention to the ratios of gas/catalyst/water in the reactor. System pressure versus temperature and catalyst concentration will be studied. Catalyst lifetime and regeneration requirements will be investigated. Utilization of the aqueous system as a gas scrubbing system in conjunction with the water-gas shift will be evaluateed with emphasis on reforming coal gasification tars and oils as well as stripping hydrogen sulfide and ammonia. Successful completion of the first phase of the project will: establish optimum operating conditions; determine pressure effects and limitations; establish catalyst lifetimes; obtain kinetic information; determine H_2S removal efficiencies; establish tar and oil removal/conversion efficiencies; determine catalyst regeneration/recycle requirements and catalyst costs; establish effect of gas residence times and concentration on conversion efficiencies; determine possible improvement to current technology; and establish cost savings/benefits.

47284 (EPRI-AP—3579) Operation of the Wilsonville Advanced Coal Liquefaction R and D Facility, 1981. Annual report. Aug 1984. Contract AC22-76ET10154. 197p. NTIS, PC A09/MF A01; 1 - EPRI; GPO Dep. File Number DE85001912.

This report summarizes the 1981 operating and test data obtained at the six ton per day Advanced Coal Liquefaction Research and Development Facility in Wilsonville, Alabama. Special emphasis is placed on data accumulated during the fourth quarter of 1981. The Wilsonville R and D Facility was in operation 71% of 1981 (70% of the fourth quarter) with scheduled shutdowns accounting for 23% of the downtime (28% during the fourth quarter). Kentucky 9 coal from the Fies mine was processed in all runs conducted during 1981 (Runs 222 through 235). The hydrotreater (HTR) unit was brought on stream successfully in May 1981. The three process units of the Wilsonville facility were operated in a non-integrated mode during the second half of 1981. Significant data was obtained and is summarized.

47285 (EUR—9044-EN) Production of distillate fuels and chemical feedstocks from coal (Report on ECSC contract 7220-EC/817). (Commission of the European Communities, Luxembourg). 1984. 183p. European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

Tests in a 5kg/h continuous plant have demonstrated the potential of supercritical gas extraction as the basis of a two-stage coal liquefaction process. Distillate products from the liquid solvent extraction process were converted to gasoline and diesel fuel, or, after hydrogenation were cracked to produce olefinic and aromatic chemical feedstocks. A general assignment scheme was devised for /SUP/1/SUP/3C NMR spectra of coal-derived materials, and spin-echo measurements enabled peaks to be unambiguously assigned to C, CH, CH/SUB/2 and CH/SUB/3 groups. NMR methods were devised for investigating oxygen and nitrogen groups in extract fractions, and an NMR procedure for estimating the concentration of donatable hydrogen in coal solvents was devised.

47286 (EUR—9047-EN) Selection and control of the properties of the coal charge in formulating blends (Report on ECSC contract 7220-EB/817). (Commission of the European Communities, Luxembourg). 1984. 92p. European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

Pilot plant scale studies were made using a range of coking blend formulations to develop understanding of the functions of low-volatile additives, of both fusible and infusible types, in improving the physical quality of coke made from high-volatile base coals of high and low dilation characteristics. The effects on coke quality of charging blends by the conventional wet method and after preheating and partial briquetting were investigated.

47287 (EUR—9048-FR) Formed coke - manufacture of a special coke with a low reaction threshold (Report on ECSC contracts 6220-EB/3/304 and 7220-EB/304). (Commission of the European Communities, Luxembourg). 1984. 36p. (In French). European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

An investigation was carried out into the possibility of manufacturing a special coke, that could be mixed with standard blast furnace coke charge, to reduce the temperature at which gasification begins from 950 C to 850 C. Experimental tests showed that the coal blend must contain a large proportion of low-rank coal and the mixture must be carbonized at a fairly low temperature in a traditional oven or be agglomerated to form an ovoid and carbonized as for formed coke. In every case, the mechanical characteristics of the special coke were inferior to those of normal metallurgical coke.

47288 (EUR—9053-DE) Chemical and physical valorization of coal (Report on ECSC contract 7220-EC/115). Oelert, H.H.; Meier zu Koecker, H.; Gundermann, K.D.; Abel, O.; Herrmann, D. (Commission of the European Communities, Luxembourg). 1984. 57p. (In German). European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

Investigations were carried out into coal liquefaction and extraction, thermal beneficiation of hard coal, and beneficiation of coking by-products. In particular, work was conducted on: the conversion of hard coal with CO and water, which was found to be unsuccessful (although brown coals can be hydrogenated in this way); characterization of coal oils by mass spectrometry; residue discharge in fluidized bed extraction of coal; use and regeneration of palladium salts for pre-separation of sulphur compounds from hydrocarbon mixtures; use of chemiluminescence in analysis of the chemical structure of coal products; development of solid-state NMR spectroscopy; use of fluorescence of vitrinites as an indication of the true rank and dilatation properties of coals; study of the kinetics of the process by which pre-carbonized coals are activated with steam; hydrolytic separation of hydrocyanic acid from gas; desulphurization of crude phenanthrene with sodium under hydrogen pressure for improved production of anthracene; improvements in the beneficiation of naphthalene by conversion into polymerizable BETA-isopropenyl naphthalene.

47289 (EUR—9054-DE) Coal conversion by hydrogenation (Report on ECSC contract 7220-EC/113). (Commission of the European Communities, Luxembourg). 1984. 75p. (In German). European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

Comparative hydrogenation tests were carried out on various coals to identify differences in the hydrogenation properties and to determine the causes of these differences. Thermal cracking of coal medium distillates such as tetralin and t-decalin, which were taken as model compounds, was investigated. Studies were also carried out on unconventional hydrogenation systems, and on characterization of non-boiling coal digestion products.

47290 (LBL—17908) Erosivity of coal particles in coal-solvent slurries. Levy, A.; Jee, N.; Sorell, G. (Lawrence Berkeley Lab., CA (USA); Exxon Research and Engineering Co., Florham Park, NJ (USA)). Jun 1984. Contract AC03-76SF00098. 39p. (CONF-8406197—1). NTIS, PC A03/MF A01; GPO Dep. File Number DE84016905.

From ASTM international symposium of slurry erossion: uses, applications and test methods; Denver, CO, USA (26 Jun 1984).

An investigation of the erosivity of particles of several different coals and respective vacuum bottoms from the Exxon Donor Solvent (EDS) coal liquefaction pilot plant Exxon Coal Liquefaction Process (ECLP) was carried out. Kerosene and tetrahydrofuran (THF) were used as the liquids in slurries containing 30 wt % particles. The particles were of several sizes, shapes, integrities (fracture strengths) and ash contents. It was determined that the primary factors having a direct effect on erosivity were particle size, and ash content/composition. Particle shape and resistance to fracturing upon impact had important secondary effects. All of these factors are interrelated and can counter each other under certain conditions. Slurry pot testing proved valuable as a reproduceable method for comparative erosion studies, but should not be relied upon to produce quantitative erosion data for equipment design purposes. 7 references, 9 figures, 5 tables.

47291 (NERDDP-CS—83-9) Independent evaluation of CSIRO flash pyrolysis. 1983. 514p. National Energy Research, Development and Demonstration Council, Canberra, Australia.

The objective of this evaluation is to assess and report on, in the context of Australia's need to develop alternative liquid fuels, the potential commercial viability of the CSIRO process for the conversion of selected Australian coals to marketable liquid fuels. The evaluation was to include consideration of: the flash pyrolysis process standing alone, an integrated flash pyrolysis/electricity generation process, and an integrated flash pyrolysis/indirect liquefaction complex.

47292 (PB—84-189091) Thermodynamic characterization of conversion process oils as materials of continuous distribution. Annual report January-December 1983. Weil, S.A.; Abbasian-Amin, M.J. (Institute of Gas Technology, Chicago, IL (USA)). Mar 1984. 63p. NTIS, PC A04/MF A01.

Examination of the more common description of continuous oils as made up of a set of pseudocomponents showed the potential of describing vapor-liquid equilibria of these oils in terms of a few (5 to 10) parameters, if the shape of the distribution function can somehow be inferred. A proposed description considers the continuous oil as made up of a set of fractional continuous oils. If the choice of distribution functions for those fractional oils is appropriately based on the vapor pressure-boiling point-temperature dependence, the form of the functions are maintained in equilibrium vapor-liquid transformation with explicit transformation rules for the parameters. A preliminary application of these concepts to a hypothetical oil has shown they can describe flashing operations. To determine the type of distribution function that should be used, a low-pressure batch distillation system was constructed to allow measurement of K value distributions for process oils over a range of temperatures. Initial experimental results are qualitatively consistent with the assumptions made in the proposed continuous oil description.

47293 (PB—84-209469) Mathematical model for a fluidized-bed coal gasifier. Final report August 1980-August 1983. Purdy, M.J.; Felder, R.M.; Ferrell, J.K. (North Carolina State Univ., Raleigh (USA). Dept. of Chemical Engineering). Jun 1984. 237p. NTIS, PC A11/MF A01.

The report gives results of gasifying four fuels--a devolatilized Kentucky bituminous coal, a New Mexico subbituminous coal, a North Carolina peat, and a Texas lignite--with steam and oxygen in a pilot-scale fluidized-bed reactor. Experimental results were used to provide an evaluation of mathematical models developed for the gasifier. A simple three-stage gasifier model and a two-phase bubbling-bed model were developed. Model options include allowance for a jetting region at the gas inlet of the bed and elutriation of fines. Gasification reactions in both models are described by Johnson kinetics. The models were applied to the gasification of the devolatilized Kentucky bituminous coal and the New Mexico subbituminous coal. Parameter optimizations were performed with each model for each feedstock. The main difference in the optimal values was in char reactivity, for which that of the New Mexico coal was roughly an order of magnitude greater than that for the Kentucky char. Using the optimal values, the models were applied to all experimental runs with these two coals. The resulting model predictions and experimental results showed reasonably good agreement in all cases.

47294 (PB—84-214410) Evaluation of coal conversion catalysts. Annual report January-December 1983. Lee, A.L. (Institute of Gas Technology, Chicago, IL (USA)). May 1984. 28p. NTIS, PC A03/MF A01.

See also PB84-104876.

The GRI-C-600 catalyst has higher activity (30+%) than the GRI-C-500 catalyst in the presence of a high CO2 (40%) concentration. Both catalysts are being life-tested and have been on-stream for more than 1000 hours, using a Lurgi-type (0.6 mole percent H2S) raw gas (Western coal). The sulfur-resistant GRI-C-318 catalyst was evaluated for the steam reforming of a sulfur-containing (21 ppm H2S) natural gas at low temperatures (700 to 1100F), and the results are comparable to those reported by other investigators using other types of sulfur-tolerant catalysts. To provide design data for the economic/process evaluation of both the base case and the direct methanation case in a Westinghouse gasification process, a set of experiments was conducted to study the COS hydrolysis and hydrogenation reactions. Near-equilibrium (50F approach) conversions were measured for the water-gas shift reaction, but away-from-equilibrium (250F approach) conversions were measured for the COS hydrolysis/hydrogenation reactions.

47295 (SAND—83-2597C) Helical screw rheometer: an advance in instrumentation for direct coal liquefaction. Chapman, R.N.; Kraynik, A.M.; Aubert, J.H.; Hawn, D.C. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 21p. (CONF-841121—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE84012905.

From AIChE annual meeting; San Francisco, CA, USA (25 Nov 1984).

Sandia has developed and tested the novel Helical Screw Rheometer to study gelling and vacuum bottoms in direct liquefaction processes. This device, which is essentially an extruder, has inherent advantages over conventional rheometers because it eliminates flow rate and torque measurements. Theory and representative data are presented. Although the HSR was conceived to study slurry gelling, it has widespread applications - primarily because conventional rheometers are not well-suited for high-pressure and high-temperature uses. In particular, a suitable rheometer is lacking for on-line applications in petro-chemical and polymer processing plants, where viscosities are very sensitive to slight variations in composition and process conditions. The HSR is suitable for on-line uses because it has the simplicity of a rotational rheometer and the range of a capillary rheometer. Also, the HSR can handle yield stress fluids; because the flight forces the fluid to flow, the fluid cannot set and plug the rheometer. 11 references, 7 figures.

47296 (UCRL—91252) Centralia partial seam CRIP underground coal gasification experiment. Cena, R.J.; Hill, R.W.; Stephens, D.R.; Thorsness, C.B. (Lawrence Livermore National Lab., CA (USA)). Jun 1984. Contract W-7405-ENG-48. 38p. (CONF-841121—5). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE84015042.

From AIChE annual meeting; San Francisco, CA, USA (25 Nov 1984).

This report describes the result of the partial seam controlled retracting injection point (CRIP) underground coal gasification (UCG) field experiment carried out at the Washington Irrigation and Development Company (WIDCO) Mine near Centralia, Washington, in the fall of 1983. The test was designed to take advantage of the high-wall geometry at the mine and was carried out near the site of the earlier (1981 to 1982) large-block experiments. The primary goals of the experiment were to test the CRIP concept and to further evaluate the site as a potential for the future development of UCG.

47297 Catalytic action of minerals in the low temperature oxidation of coal. Herman, R.G.; Cole, D.A.; Klier, K.; Kuzmicz, V.; Simmons, G.W. (Center for Surface and Coatings Research, Sinclair Laboratory No. 7, Lehigh University, Bethlehem, PA). *Fuel;* **63**: No. 5, 673-678(May 1984).

The mild oxidation of coal by air in a fluidized-bed reactor has been studied by utilizing X-ray powder diffraction, scanning electron microscopy accompanied by energy dispersive X-ray analysis and Mossbauer spectroscopy. These techniques show that some of the highly dispersed minerals in coals undergo changes concurrently with the reactions of the coal matter. An oxidation treatment at a reactor temperature of 350°C transforms most of the pyrite (FeS_2) into hematite (Fe_2O_3) and the calcite ($CaCO_3$) into anhydrite ($CaSO_4$). Pronounced pitting of the coal surface was observed in the vicinity of mineral crystallites and particles. Calcium was present as a dominant element in those minerals that caused the oxidative pitting to occur most rapidly.

47298 Effects of catalysts and CO_2 gasification on the E.S.R. of carbon black. Sancier, K.M. (SRI International, Menlo Park, CA). *Fuel;* **63**: No. 5, 679-685(May 1984).

An in-situ E.S.R. study has been carried out of the effects of temperature up to 970 K and of CO_2 gasification on mixtures of various salts with carbon black. Two main classes of salts are studied: (1) potassium salts with various anions; and (2) alkali metal carbonates. Various E.S.R. parameters are measured: line-width, first moment, and two E.S.R.-derived electrical conductivity parameters, Δ/ /SUB p/ $^{-1}$ and Δ/ /SUB D/ / /SUB p/ relates to the E.S.R. cavity sensitivity, and Δ/ /SUB D/ is the change in the bias current of the crystal diode detector of the microwave bridge. Generally, heating salt-carbon black mixtures in helium results in both a reversible and an irreversible increase in the line-width and the electrical conductivity of the samples, but essentially no change in the first moment. At temperatures $>$800 K, upon switching to CO_2 gasification conditions, the line-width and electrical conductivity decrease and the first moment (i.e., free radical concentration) increases. The extent of these changes depended strongly on the nature of the salt: for a given cation the change varies with the anion, and for a given anion it is affected by the cation. The changes in the E.S.R. parameters are discussed in terms of thermally-produced saltcarbon black interactions and how they are modified by the gasification reaction. The reported catalytic gasification activities of the salts appear to correlate well with the changes in the E.S.R. parameters produced by gasification conditions, but not as well with the changes in the E.S.R. parameters produced by a thermal treatment.

47299 Molecular weight distributions of tars produced by flash pyrolysis of coals. Unger, P.E.; Suuberg, E.M. (Department of Chemical Engineering, Carnegie-Mellon University, Pittsburgh, PA). *Fuel;* **63**: No. 5, 606-611(May 1984).

The molecular weight distributions of tars produced during flash pyrolysis of coal have been determined by a combination of gel permeation chromatography and vapour phase osmometry. Small particles (62-88 μm) of two high-volatile and one low-volatile bituminous coal, and a lignite have been pyrolysed at heating rates of $\approx$ 1000 Ks^{-1} at temperatures from 600 to 1300 K in a heated wire mesh apparatus. The molecular weight distributions range from $\approx$ 100 to 4000 and peak in the range from 250 to 750 in all cases. The evidence gathered on a softening bituminous coal clearly indicates a selective evaporation of light fractions of the metaplast.

47300 Mechanical problems in the design of a fixed-bed, slagging gasifier. Hauserman, W.B.; Willson, W.G. (Grand Forks Energy Technology Center, (U.S.D.O.E./University of North Dakota), Grand Forks, North Dakota). pp 147-170 of Technical economics, synfuels and coal energy symposium. Dicks, J.B. New York, NY, USA; A.S.M.E. (1984). (CONF-831111—).

From ASME winter annual meeting; Boston, MA, USA (13 Nov 1983).

Pressurized, fixed-bed gasification of coal with steam and oxygen is now a well established commercial technology. It appears commercially feasible to operate a gasifier at three to five times the capacity per vessel cross section than is presently possible with the conventional dry-ash gasifiers, with a corresponding decrease in steam consumption and wastewater disposal. This requires that partial oxidation and steamchar reactions be carried out at temperatures locally exceeding the melting point of the coal's mineral components, which leave the reaction vessel as a molten slag. The reaction zone must be controlled to avoid excessive thermal, chemical and abrasive destruction of refractory walls, while keeping the slag fluid until it can fall clear of a taphole, heated by external burners, and into a quench bath. Higher in the fuel bed, where drying and devolatilization take place, the coal's settling behavior and tendency to form stable bridges are determined by its chemical and less thoroughly studied structural properties. This paper covers operating experiences with such a slagging, fixed-bed pilot gasifier and establishes some design criteria for mechanical components.

47301 Computer simulation of Westinghouse fluidized-bed cold-flow experiments. Padhye, A.; O'Brien, T.J. (Department of Mechanical and Aerospace Engineering, West Virginia University, Morgantown, West Virginia). pp 77-86 of Gas-solid flows. Vol. 10. Jurewicz, J.T. New York, NY, USA; A.S.M.E. (1984). (CONF-831111—).

From ASME winter annual meeting; Boston, MA, USA (13 Nov 1983).

A mechanistic model for the simulation of fluidized-bed gasifiers, based on fundamental equations of physics and chemistry, was developed by Systems, Science, and Software, Inc. (S^3), under contract to the U.S. Department of Energy's (DOE) Morgantown Energy Technology Center (METC). The fluid and particle dynamics are described by the governing partial differential equations determined by the conservation of mass, momentum, and energy. Constitutive relations are specified to described gas/particle drag, solid-phase pressure and viscosity, and gas-phase pressure and viscosity. The two-dimension form of these equations (Cartesian or axially symmetric) were represented in a finitedifference form which is solved using an iterative scheme based on the implicit continuous fluidenterian method. This code was acquired from S^3 and implemented on the METC VAX 11/780 System. The input parameters of the code were adjusted to describe an axially symmetric reactor with a central jet (radius = 1.24 cm), an annular char-ash separator (outer radius = 6.82 cm), and a conical grid (outer radius = 12.4 cm). These dimensions were chosen to correspond to the 30-cm, semicylindrical experimental facility used by Westinghouse for a variety of experiments. The simulation imposses axial symmetry although the experiments are not symmetric, especially in the region of the jet, near the front plate. The dimensions of the simulation were adjusted slightly from those of the experiment so as to match flow rates and mass flux. The rationale for these choices and the effect on the simulations are discussed in detail.

47302 (CONF-830664—6-Trans.) Research in France on underground coal gasification. Donat, G. Translated from *Proceedings of the International Gas Research Conference ;* 551-563(1983). 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84017116.

From International gas research conference; London, UK (13 Jun 1983).DE84017116

The program of research from 1979 to 1984 corresponds to a budget of 155 million francs and includes theoretical studies, laboratory work and experiments on site. At the depths considered, coal is compact and not permeable. Numerical models of gasification, which are available at small depths and which stimulate a fluid circulation by permeation through coal layers, are not suitable. Therefore, Group on Underground Gasification (GEGS) is developing a new model proceeding from a physical approach which takes into account elementary phenomena and their interactions all along the gas channel. A first on-site feasibility field test was made during the period from March 1980 to July 1981 and BRUAY-en-ARTOIS (Nord) and gave the three following positive results: a 1170 m deep coal seam was fractured under water pressure; and, for the first time in the world at such a depth, allowed the creation of a link between two drills, 65 m apart; the quality of the link was controlled by circulation of water and then of nitrogen; and ignition of the coal enabled counter-current combustion to be initiated and thus defining better the conditions under which combustion should be continued. A new experiment is underway on another site, the HAUTE DEULE, near LENS (Pas-de-Calais) aiming at more ambitious objectives than in BRUAY-en-ARTOIS. Experiments have been made since 1981 at the ECHAUX (Loire) in a shallow coal layer. They have already allowed the linking of two wells, 10 m apart, by electrocarbonization. Despite these first partial successes, there are still important and numerous problems to be solved in order to turn underground coal gasification into an industrial operation. The energy which would be recovered if the work is successful, justifies these research efforts. 3 references, 7 figures.

47303 **Refractory liners for slagging coal gasifiers.** Firestone, R.F.; Kennedy, C.R. (IIT Research Institute). pp 480-490 of Proceedings of the 1981 international gas research conference. Rockville, MD, USA; Government Institutes, Inc (1982). (CONF-810909—).

From International gas research conference; Los Angeles, CA, USA (28 Sep 1981).

Slagging gasifiers operate at temperatures where coal ash melts to form an aggressive slag that coats the interior. To achieve long lives as liners for these gasifiers, currently available refractories require copious cooling, with attendant high heat losses. This paper reviews the state of the art of refractory liners for slagging coal gasifiers. Conceptual designs for liners based on experience with comparable industrial processes are described. The results of experiments on the mechanisms of slag corrosion of refractories and methods for its suppression are discussed. The design of a facility to test refractory liners under simulated coal-gasification conditions is described.

47304 **Computer simulation of internal processes in coal gasifiers.** Scharff, M.F. (JAYCOR). pp 408-417 of Proceedings of the 1981 international gas research conference. Rockville, MD, USA; Government Institutes, Inc. (1982). (CONF-810909—).

From International gas research conference; Los Angeles, CA, USA (28 Sep 1981).

Computer movies are shown that depict fluid motions, temperature, and composition profiles within entrained flow and fluidized-bed gasifiers. These movies are automated output from detailed computer simulations of the time-dependent two-phase fluid dynamics, heat transfer, and chemical reactions occurring in hundreds of spatial regions within gasifiers. Turbulence, radiation, and slag flow are included in the entrained-flow model. Transitions from dilute-phase flow to dense-phase flow with bubbling occur in the fluidized-bed model. Both transient and steady states are shown. Advances in computer technology now make it possible to run these simulations in less than an hour on high-speed computers such as the CDC 7600, so that the results may be used to plan experiments in a pilot test series and guide the choice of alternatives for scale-up.

47305 **The potential of small-scale underground coal gasification plants.** Burwell, E.L.; Wieber, P.R. (U.S. Department of Energy). pp 398-407 of Proceedings of the 1981 international gas research conference. Rockville, MD, USA; Government Institutes, Inc. (1982). (CONF-810909—).

From International gas research conference; Los Angeles, CA, USA (28 Sep 1981).

This paper presents the results of several studies directed toward assessment of the potential of small scale underground coal gasification (UCG) plants as a valid domestic synthetic fuel option. Capital and operating costs were calculated for UCG-to-methanol plants in size ranges from 160 to 5,000 metric tons per day along with product prices and local economic, supply, and socioeconomic impacts. The studies show that methanol can be produced at highly competitive prices in many areas and with acceptable impacts.

47306 **In-situ coal gasification - a new technology.** Agarwal, A.K.; Fielinski, R.E. (Monsanto Research Corporation, Mound Facility). pp 384-397 of Proceedings of the 1981 international gas research conference. Rockville, MD, USA; Government Institutes, Inc. (1982). (CONF-810909—).

From International gas research conference; Los Angeles, CA, USA (28 Sep 1981).

Recent data show a total U.S. coal resource base of about 6.4 trillion tons. A commercial Underground Coal Gasification (UCG) process could roughly quadruple the 450 billion tons of U.S. coal reserves which are presently recoverable by mining. There is approximately 900 billion tons of bituminous coal resource which are located near high population and high energy use centers. Approximately 200 billion tons of this bituminous resource, which is comparable to the estimated mineable reserves, can be recovered by UCG since the coal seams cannot be mined economically. In addition, a large fraction of the seams that possibly could be mined exhibit a high sulfur and mineral content which potentially could limit any use of the coal because of environmental regulations. This necessitates the need to develop a viable technology to recover these bituminous coal resources. The Pricetown I test demonstrated the high potential of UCG in bituminous coals. To meet the requirements of a commercial demonstration, a three phase plan is proposed for the commercialization of this technology. Phase I of this plan addresses the issues still remaining in the swelling bituminous coals of the Appalachian basin, whereas Phase II initiates the technology in the untested Illinois basin and Phase III evolves from Phase II to provide a commercial demonstration in the Illinois basin near existing energy markets.

47307 **High temperature desulfurization of coal gases by regenerative sorption.** Jalan, V. (Giner, Inc.). pp 291-303 of Proceedings of the 1981 international gas research conference. Rockville, MD, USA; Government Institutes, Inc. (1982). (CONF-810909—).

From International gas research conference; Los Angeles, CA, USA (28 Sep 1981).

This study consisted of an evaluation of: the desulfurization/regeneration performance of unsupported ZnO, V_2O_5/ V_2O_3, WO_3/WO_2 and CuO/Cu sorbents; an investigation of alternate routes for the regeneration of ZnO; and the development of a desulfurization model to facilitate design of sorbent pellets. Based on detailed thermodynamic calculations and overall practical considerations, ZnO, V_2O_3, Cu and WO_2 were identified as sorbent materials with attractive desulfurization and regeneration properties at intermediate to high temperatures, (350-700°C). In desulfurization studies at 650°C, sulfur loadings obtained were 0.45, 0.7 and 0.6 percent of the theoretical capacity for the unsupported V_2O_3, Cu and WO_2, respectively and 5.5 percent for catalyst grade high surface area ZnO. These loadings correspond to the H_2S effluent concentration of 10 ppmv from a 200 ppmv H_2S in simulated coal gas. Regenerability is achieved by air oxidation of the spent sorbent with all four agents. Following air oxidation, V_2O_5, CuO and WO_3 require a reduction step to form V_2O_3, Cu and WO_2 which had been identified to be the active species. Low specific surface area is the principal factor limiting the sulfur loadings in unsupported state. Although better than 90% regeneration was achieved by air oxidation between 650 and 800°C, the regeneration by steam-air mixture was found to be more effective; the use of steam-air mixture increased the sulfur removal efficiency and caused little structural degradation. Characterization of fresh, sulfided and regenerated materials by electron microscopy, microanalysis and low temperature nitrogen adsorption measurements provided information on the distribution of sulfur, pore structure and surface area, and strong evidence that sulfiding leads to pore plugging.

47308 **The potential supply of synthetic fuels from Alaskan hydroelectric power and coal.** Steinberg, M.; Powell, J.R. (Process Sciences Division, Department of Energy). pp 260-274 of Proceedings of the 1981 international gas research conference. Rockville, MD, USA; Government Institute, Inc. (1982). (CONF-810909—).

From International gas research conference; Los Angeles, CA, USA (28 Sep 1981).

It is proposed to develop and utilize the large potential hydroelectric power resources in Alaska to produce hydrogen by the electrolytic decomposition of water and to combine the hydrogen with the large Alaskan coal reserves to produce synthetic liquid and gaseous fuels. It is estimated that in this manner, as much as 1.8 million bbls/day of gasoline or 6.2 billion SCF/day of substitute natural gas can be produced. The existing and projected Alaskan pipelines would provide the means of transporting the fuels to energy consuming load centers in the U.S. This development would move the U.S. a considerable way towards energy independence as well as employing the material resources in Alaska in an efficient manner.

47309 **Instrumentation for control of coal gasification processes.** O'Fallon, N.M. (Argonne National Laboratory). pp 252-259 of Proceedings of the 1981 international gas research conference. Rockville, MD, USA; Government Institutes, Inc. (1982). (CONF-810909—).

From International gas research conference; Los Angeles, CA, USA (28 Sep 1981).

A survey of instrumentation needs in advanced fossil energy processes is being conducted by Argonne National Laboratory (ANL) for the U.S. Department of Energy (DOE). This updates a 1976 study of process control instrumentation needed for large-scale coal gasification, liquefaction, and fluidized-bed combustion systems. Deficiencies in process control instrumentation are similar across the fossil energy technologies and include measurement of multiphase mass flow at elevated temperatures and pressures, in-stream compositional analysis, measurement of elevated temperatures, monitoring of levels, and pressure measurements. A program of instrument development at ANL has been funded by the DOE (or its predecessor) for the past three years. Work has concentrated on the multiphase flow measurement problem and the in-stream compositional analysis area. Flow instruments that have been developed and tested in coal gasification pilot plants include acoustic/ultrasonic cross correlation and capacitive sensing for solid/liquid ratio and velocity by cross correlation in the HYGAS Pilot Plant slurry feed line. A passive acoustic flow-no flow indicator was developed for the char injection lines of the BI-GAS Pilot Plant. This paper presents results of the survey of process control instrumentation needs for coal gasification systems. It briefly reviews results of the pilot plant tests and describes further developments of the acoustic/ultrasonic and capacitive instruments, as well as new techniques that will soon be ready for in-plant testing.

47310 **Exxon's catalytic coal gasification process.** Mirsch, R.L.; Gallagher, J.E. (Exxon Research and Engineering Company). pp 207-217 of Proceedings of the 1981 international gas research conference. Rockville, MD, USA; Government Institutes, Inc. (1982). (CONF-810909—).

From International gas research conference; Los Angeles, CA, USA (28 Sep 1981).

Catalytic Coal Gasification (CCG) is being developed as a more efficient, lower cost approach to producing methane from coal. A potassium catalyst permits operation of all reactions at one temperature so that endothermic and exothermic reactions can be heat integrated in a single reactor. A key aspect of the concept involves continuous recycle of product CO and H_2 to the gasifier following separation of methane. The process has advanced steadily since the basic concept was conceived in 1971. A 23 day demonstration run in a 900 kg/day Process Development Unit was recently completed. The next major program step will be to design and construct a large pilot plant to bring CCG technology to commercial readiness in the later 1980's.

47311 **A concept for the production of high BTU gases from peat, lignite and low rank coals utilizing concentrated solar thermal energy.** Humphrey, M.F.; Evans, M.M. (Jet Propulsion Laboratory). pp 190-206 of Proceedings of the 1981 international gas research conference. Rockville, MD, USA; Government Institutes, Inc. (1982). (CONF-810909—).

From International gas research conference; Los Angeles, CA, USA (28 Sep 1981).

This paper describes the work to date on a concept to produce fuels and/or chemical intermediates from peat, lignite and low bituminous coals without the prior removal of the "as mined" water. The primary objective of the work was to examine the potential of carrying out a pyrolysis in a liquid transport media (as opposed to a gas). A Pyroprobe, gas chromatograph, and mass spectrometer were used for this initial phase of the work. The Pyroprobe offered a rapid means of examining the effects of temperature, time, catalysts and heat transfer fluids on the products produced by the "wet pyrolysis". Results from this study are to be used to design and operate a bench scale unit that can be adapted to a solar energy source.

0105 By-products

REFER ALSO TO CITATION(S) 01050047320

0106 Properties

REFER ALSO TO CITATION(S) 01060047281, 47286, 47287, 47289, 47297, 47298, 47299, 47337, 47372, 47405, 47408, 47410, 47413, 47445, 47446, 48248, 48253, 48267

47312 **(CONF-841185—1) Viscosity of synthetic coal slags as a function of composition, temperature and oxygen partial pressure.** Vorres, K.S.; Greenberg, S.; Poeppel, R.B. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84015822.

From 2. international symposium on metallurgical slags and fluxes; Lake Tahoe, NV, USA (11 Nov 1984).

The viscosities of 21 synthetic coal slags (30 to 50 wt % SiO_2) were measured as a function of temperature under oxygen partial pressures (about 10^{-8} to 10^{-9} atm) and, in some cases, under an ambient air environment. The viscosity of any given slag composition is a single-valued function of the temperature and oxygen partial pressure and does not exhibit a hysteresis effect. The measured viscosities were significantly different from the viscosities one would predict from two of the more commonly used viscosity-temperature-composition correlations. The sensitivity of viscosity to oxygen partial pressure was greatest for the slags with high iron content. An examination of log reciprocal viscosity versus reciprocal absolute temperature indicates that many slags went through a transition near temperatures corresponding to final solidification in a related ternary phase equilibrium diagram. 5 figures.

47313 **(DOE/FE/60181—1648) Some physical chemical concepts relevant to coal science.** Neumann, R.M. Sep 1984. Contract FC21-83FE60181. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE84017087.

This report discusses approaches to understanding certain physical and physical chemical properties of low-rank coals from a molecular perspective. Dielectric relaxation measurements are described which have identified two distinct modes of water incorporation in lignite. The theoretical aspects of dielectric relaxation are presented along with the experimental details. The need for performing vapor pressure measurements on lignite-water vapor equilibrium systems is examined. In recent years, many researchers have attempted to understand the macromolecular network in coal by means of techniques useful for studying bulk polymers. Here, the underlying theoretical ideas are presented for dynamic mechanical relaxation and rubber elasticity. Researchers have drawn inferences, from the measurement of viscoelastic properties of coals, about the molecular nature of the crosslinking in the organic network. Their conclusions are critically examined and suggestions are made as to how the experimental procedures might be improved. The interpretation of the temperature dependence of slag viscosity is a particularly vexing problem. Here, it is suggested that the theoretical methods used to describe the viscosity of molten glasses may be useful as a point of departure in characterizing slag viscosities. Finally, a brief outline of the Hildebrand theory of liquid-liquid miscibility is presented; the ideas relevent to understanding supercritical solvent extraction of coals in terms of the Hildebrand solubility parameter are discussed. 28 references, 22 figures.

47314 **(DOE/LC/00022—1599) Analytical aspects of the Fossil Energy Waste Sampling and Characterization Project.** Jackson, L.; Moore, F. Mar 1984. Contract AP20-84LC00022. 222p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE84009266.

This report details the results of the Fossil Energy Waste Sampling and Characterization Project, an extensive DOE project to develop a high quality data base on the leaching characteristics of coals and their combustion wastes. During the performance of this work, the EP toxicity test required by the Resource Conservation and Recovery Act (RCRA) was evaluated for overall precision when applied to fossil energy wastes. An additional test using water as a leach medium, was developed and evaluated under the same conditions. The precision of each test was dependent on the metals being determined in the leachates. The EP toxicity test showed coefficients of variation ranging from 15 to 100 percent and the water test (which later became ASTM Method D 3897) gave values of 30 to 120 percent. Both tests were applied to more than 80 coals and wastes in a multi-laboratory study with participation from DOE Energy Technology Centers, National Laboratories, National Bureau of Standards, and numerous commercial laboratories. The results of 2492 different leach tests and attendant analytical results are reported. The comparison of the analytical results with the permissable RCRA limits of 100 times the current drinking water standards shows that no coal or waste exceeds the limit at the 95 percent confidence level. The report also contains a brief summary of the sampling activity carried out at 18 utility sites and 6 emerging energy technology locations. 12 references, 1 figure, 32 tables.

47315 **(DOE/OR/03054—116-Vol.1) Existing technology transfer report: analytical capabilities. Volume 1.** Tewari, K.C. (Air Products and Chemicals, Inc., Allentown, PA (USA)). Jun 1984. Contract AC05-78OR03054. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85001634.

The overall objective of the on-going analytical efforts was to develop in-house expertise and analytical capability for the analysis of coal and coal-derived products in support of SRC-I process technology. The approach taken and work accomplished involved: identification of test methods and associated equipment; review and implementation of analytical facility plan; evaluation of existing instrumentation; evaluation and purchase of new instruments; training of laboratory personnel; validation or development of analytical methods; development of standard product work-up methods; and development of analytical protocol for detailed characterization of SRC-I solid and liquid products. Expertise in analytical chemistry was developed by organizing historical knowledge and assimilating new knowledge as it became available from inside and outside research facilities and the chemical literature. The data were then used to define analytical methods, instrumentation, space, staff needed to create a functional coal analysis laboratory. This report summarizes the direction and progress of the analytical development efforts during the period 1974 to 1980. 2 references, 5 figures.

47316 **(DOE/OR/03054—116-Vol.2) Existing technology transfer report: analytical capabilities. Volume 2. Appendix A.** Tewari, K.C. (Air Products and Chemicals, Inc., Allentown, PA (USA)). Jun 1984. Contract AC05-78OR03054. 187p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85001635.

This volume contains 10 attachments entitled: Monthly progress reports; Method CHN-4 (Carbon, Hydrogen and Nitrogen analysis by Perkin-Elmer elemental analyses); Method Oxygen-6 (oxygen analyzer); Method Nitrogen-8 (Low level nitrogen analysis by Perkin-Elmer 240 elemental analyzer); Method Sulfur-10 (sulfur analysis by oxidative microcoulometry); Method TGA-3 (thermogravimetric analysis of coal liquefaction products and process solvents); Method DSC-5 (Determination of glass transition temperature by differential scanning calorimetry); Method GC-1 (gas chromatography of Fischer-Tropsch products); Method GC-2 (gas chromatography of distillate products from coal liquefaction); Analytical Method No. 1160 (estimation of OH, NH, NH_2, concentration in methylene chloride soluble materials from SRC liquids); x-ray diffraction method for determining the orientation tendency in calcined coke; and evaluation of mass spectrometers.

47317 **(DOE/OR/03054—116-Vol.3) Existing technology transfer report: analytical capabilities. Appendix B. Volume 3.** Tewari, K.C. (Air Products and Chemicals, Inc., Allentown, PA (USA)). Jun 1984. Contract AC05-78OR03054. 204p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE85001636.

The overall objective of the on-going analytical efforts was to develop in-house expertise and analytical capability for the analysis of coal and coal-derived products in support of SRC-I process technology. The approach taken and work accomplished involved: identification of test methods and associated equipment; review and implementation of analytical facility plan; evaluation of existing instrumentation; evaluation and purchase of new instruments; training of laboratory personnel; validation or development of analytical methods; development of standard product work-up methods and development of analytical protocol for detailed characterization of SRC-I solid and liquid products. This volume contains Appendix B with the following attachments: solvent separation procedure A; Wilsonville solvent separation procedure, distillation separation procedure; solvent separation modified Wilsonville Procedure W; statistical comparison of 3 solvent separation procedures; methods development for column chromatography, and application of gas chromatography to characterization of a hydrogen donor solvent; and high performance liquid chromatographic procedure.

47318 **(DOE/PC/30013—T6) Lateral variability in mineralogy and petrology of the Lower Kittanning seam, Western Pennsylvania and Eastern Ohio. Final report, Part 11.** Rimmer, S.M.; Davis, A. (Pennsylvania State Univ., University Park (USA)). Aug 1984. Contract AC22-80PC30013. 261p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE84016499.

Mineral and maceral composition is a function of physical, chemical, and biological processes operating from the time of peat accumulation to the present. The major objective of this study was to determine lateral variability in the composition of a seam and attempt to identify controls and evaluate their importance. The Lower Kittanning seam was chosen for the study because various depositional environments had been suggested previously, based on the fossil content of the overlying shales and because a wide range of rank is covered, increasing from high volatile bituminous in the west to low volatile bituminous in the southeast. Fifty channel samples were collected from western Pennsylvania and eastern Ohio, representing the different depositional environments and ranks of this coal. Analytical procedures included maceral and reflectance analysis, and mineralogical determinations using x-ray diffraction, infrared spectroscopy and normative analysis. Results indicated the importance of subsidence rates, on both a regional and local scale, which influenced water depth and chemistry of the swamp. Thickness increases towards the center of the basin, where high rates of subsidence and peat accumulation kept pace. In marginal areas, slower burial permitted more oxidation of organics, resulting in thinner coal deposits. 165 references, 57 figures, 24 tables,

47319 **(DOE/PC/50788—T5) Dissolving coal at moderate temperatures and pressures. Final report, August 20, 1982-September 30, 1984.** Mayo, F.R.; Hirschon, A.S.; Sundback, K.A. (SRI International, Menlo Park, CA (USA)). 21 Sep 1984. Contract FG22-82PC50788. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85001790.

The main objectives of this research were to make Illinois No. 6 coal liquid or soluble with inexpensive reagents (e.g., solvolysis with methanol and acids), without high pressure equipment, and to see if our soluble products would be more reactive than whole coal in liquefaction processes. These efforts are unpromising. However, efforts to make coal soluble by oxidation with nitric acid gave encouraging results. When Illinois No. 6 and Wyodak coals were allowed to stand in sunlight for 282 days, 27% of the original weight and 32% of the original carbon were lost. Concurrent experiments in the dark at 24°C indicate that these coals are fairly stable in air in the dark; light causes most of the oxidation. The solubility properties of these aged coals will not be available before the end of this grant period. Several other minor lines of work, some very interesting, are summarized in order of decreasing significance. 1 figure, 6 tables.

47320 **(EUR—9055-EN) Studies of the constitution and quality of coal tar binder pitch and refined tar in relation to commercial usage (Report on ECSC contract 7220-EB/819).** (Commission of the European Communities, Luxembourg). 1984. 53p. European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

Size exclusion chromatography was applied to the characterization of coal tar pitches, particularly those used as binders for the carbon anodes used in the manufacture of aluminium. Permeation gels based on styrene-divinyl benzene copolymers were satisfactory for the characterizations to be made. Subsidiary techniques were developed during the study, including a prior fractionation by a percolation column technique and solubilization of part of the solvent insoluble fraction of the pitch by a reductive technique.

47321 **(PB—84-189117) Multistep bond breaking and making processes of relevance to thermal coal chemistry. Annual report No. 2, February 1983-February 1984.** Stein, S.E. (West Virginia Univ., Morgantown (USA). Dept. of Chemistry). Feb 1984. 71p. NTIS, PC A04/MF A01.

See also PB83-195453. Prepared in cooperation with National Bureau of Standards, Washington, DC.

The objective of this research program is to determine chemical reaction mechanisms leading to bond formation, aromatization and char formation during the pyrolysis of polyaromatic materials. During the second year of this program, research has progressed along the three parallel pathways established in the first year. One series of studies measured rates of key single-step chemical reactions required for a detailed description of complex bond-forming processes. In these studies rates were measured for a variety of modes of hydrogen transfer between polyaromatic radicals and molecules and for a series of bond breaking reactions. Another series of studies examined the thermal decomposition of polyaromatic molecules with particular emphasis on anthracene. A detailed analysis has been carried out for this reaction and a novel reaction mechanism proposed. Finally, calculations on large aromatic layers were done using modern molecular orbital theory. These studies provide a more detailed view of these layers than possible using calculations based on less advanced theories and show several unexpected and potentially very significant results concerning electronic properties of large graphite-like molecules.

47322 **(PB—84-200666) Correlation of coal properties with environmental control technology needs for sulfur and trace elements. Final report May 1982-June 1983.** White, D.M.; Edwards, L.O.; Eklund, A.G.; DuBose, D.A.; Skinner, F.D. (Radian Corp., Austin, TX (USA)). Jun 1984. 358p. NTIS, PC A16/MF A01.

The report reviews existing reports and data on the occurrence of sulfur and trace elements in U.S. coals and on the effect of coal properties on trace element partitioning during coal use. Emphasis was on: (1) the effect of depositional conditions on the formation and composition of mineral matter in coal, (2) the elemental concentration of major and trace elements in U.S. coals as a function of rank and geographic location, (3) analytical methods used for evaluating the modes of occurrence of these elements in coal, (4) conceptual models for predicting sulfur and trace element occurrence as a function of depositional conditions and chemical equilibrium, and (5) the fate of major and trace elements during coal cleaning, combustion, gasification, and waste disposal. Coal washability data for 44 U.S. coal samples were used to statistically estimate the trace element reduction potential for a coal as a function of sulfur and ash reduction. Data fits were especially good for elements associated with the clay minerals, and to a lesser extent with the sulfides. Coal combustion data from 15 previous studies at commercial power plants were also analyzed; but, due to differences in technological processes at various plants, possible analytical errors, and limited data, statistical correlations are uncertain.

47323 **(PB—84-209212) Microanalysis methods for inhomogeneous materials. Final report on phase 1.** Hamblen, D.G.; Best, P.E. 1982. 40p. NTIS, PC A03/MF A01.

Prepared in cooperation with Connecticut Univ., Storrs. Dept. of Physics.

Results are presented of research to develop new automated procedures using the scanning electron microprobe for analyzing inhomogeneous materials such as coal and ores. Data on chemical composition of particles were used to predict the cleanability of coal. Estimates of the coal particle size distribution were used along with two facts--(1) high concentrations within a subsample imply a particle of size comparable to the subsample size, and (2) high concentrations in adjacent subsamples measure pyrite size directly--to determine the pyrite size and to predict the cleanability of two coals, PSOC 308 and 330. For PSOC 308, the quantitative agreement between prediction and actual washing measurements was good. The assumptions which must be made to bring the predictions of the microprobe data for cleaning of the PSOC 330 into agreement are noted. The need to properly calibrate and stabilize the electron beam current is emphasized.

47324 **(PB—84-213883) Lignite recovery of cobalt(+3) from an ammoniacal ammonium sulfate solution. Report of investigations/1984.** Slavens, G.J.; Traut, D.E.; Penner, L.R.; Henry, J.L. (Bureau of Mines, Albany, OR (USA). Albany Research Center). 1984. 19p. (BM-RI—8870). NTIS, PC A02/MF A01.

Library of Congress catalog card No. 83-600396.

The Bureau of Mines has devised technology to recover cobalt, nickel, and byproduct copper from domestic lateritic material using an oxidative, ammoniacal ammonium sulfate leach. Nickel, cobalt, and copper were recovered by solvent extraction and electrowinning. To reduce the cost and complexity of cobalt recovery, an alternate method using lignite to extract Co(+3) was investigated as reported herein.

47325 **(SECV—351) Breakage of single particles of raw brown coal by impact.** Dimitrakakis, P.; Willis, A.C. (State Electricity Commission of Victoria, Melbourne (Australia)). 1978. vp. State Electricity Commission of Victoria, Melbourne, Australia.

An impact test apparatus has been built to study the breakage behaviour of coal particles under single impact conditions. The effects of particle size and shape, and of impact velocities on the product size distribution for one type of coal have been examined. The results show that the product obtained from a single impact was coarse relative to that obtained from a mill.

47326 **(TVA/OP/EDT—84/28) Comparison of laboratory analyses of CONAC coal standards.** Ray, S.S. (Tennessee Valley Authority, Chattanooga (USA). Div. of Energy Demonstrations and Technology). 1984. 246p. NTIS, PC A11/MF A01. File Number DE84901968.

The large variability in the composition of coal significantly impacts the performance of coal-fired plants and coal preparation facilities, their costs of operations, and their choice of methods for meeting emissions standards. For this reason, the electric utility industry recognizes the need for a rapid continuous analyzer of coal composition and quality. Therefore, EPRI and TVA initiated a project in 1979 to demonstrate a continuous online nuclear analyzer of coal (CONAC) and evaluate its performance. Development of the CONAC was performed by a contractor (Science Applications, Inc.), and manufacturer acceptance tests have been completed. The device is now undergoing testing at TVA's Paradise Coal Washing Plant. An important factor in the future success of the device is accurate calibration to the range of coals for which it will be used. The purpose of this study was to obtain a characterization of a wide range of coal standards for calibration reference values, while optimizing the calibration for TVA coals. The characterization of coals would result from a comprehensive laboratory analysis program on these coals and statistical analysis of laboratory results. Specific objectives included comparison of analytical results from four different laboratories, including analysis of laboratory means and variability; determination of the differences among coals used in the study; analysis of homogeneity of coal standards, and analysis of constituent relationships within the coal. Variability of results among and within laboratories was of particular interest, because the goal was to use the laboratory analysis data to derive suitable reference values for calibration of the CONAC. 7 references, 44 figures, 6 tables.

47327 **(TVA/OP/EDT—84/36) High count rate enhancement of CONAC: results of laboratory acceptance tests.** Lynch, R.W.; O'Connor, D.C.; Surman, P.L. (Tennessee Valley Authority, Chattanooga (USA). Div. of Energy Demonstrations and Technology; Bechtel Group, Inc., San Francisco, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). 1984. 35p. (CONF-840924—1). NTIS, PC A03/MF A01. File Number DE84901971.

From 4. international coal testing conference; Lexington, KY, USA (10 Sep 1984).

The Electric Power Research Institute (EPRI), Tennessee Valley Authority (TVA) co-sponsored Continuous Online Nuclear

Analyzer of Coal (CONAC) was developed by Science Applications, Inc. (SAI), and has previously undergone laboratory and field acceptance tests. High count rate (HCR) electronics and computer software have been developed by SAI that will allow improvement of the CONAC germanium detector measurement cycle from 3 hours to approximately 20 minutes. This HCR enhancement was tested in the laboratory at SAI using a laboratory CONAC that did not duplicate all CONAC functions, but did allow test of the germanium detector. This paper discusses results obtained during HCR laboratory tests measuring sulfur, ash, Btu's and chlorine in coal. Data are presented for germanium detector measurement accuracy and precision tests, and also for tests examining effects of different measurement cycles and different coal-detector geometries. Plans for integrating various detector outputs into one consistent reporting methodology are also reviewed. 14 references, 12 figures, 10 tables.

47328 Characterization and classification of Rocky Mountain coals by Curie-point pyrolysis mass spectrometry. Meuzelaar, H.L.C.; Given, P.H.; Harper, A.M.; Hill, G.R. (Biomaterials Profiling Center, University of Utah, Research Park, Salt Lake City, UT). *Fuel;* **63**: No. 5, 640-652(May 1984).

A set of 102 coal samples from the Rocky Mountain coal province, selected from the Penn State Coal Sample Bank, was analysed by Curie-point pyrolysis mass spectrometry in combination with computerized pattern recognition techniques. The spectra obtained were shown to be quite representative for the coal seams with characteristic differences often present between different seams, fields or regions within the Rocky Mountain Coal province. In general, the spectra were found to be dominated by homologous ion series, e.g., representing dihydroxybenzenes, phenols, naphthalenes, benzenes, alkenes, dienes, alkyl fragments and sulphur compounds with varying degrees of alkyl substitution. The relative abundances of dihydroxybenzenes and naphthalenes were shown to correlate closely with differences in rank, whereas those of phenols, aliphatic hydrocarbons and sulphur compounds appeared to correlate more closely with differences in depositional environment. Different spectra--dominated by aliphatic compound series--were obtained from several samples of a boghead coal (Cannel King seam). Moreover, spectra of two of these boghead coal samples, known to be severely weathered, showed markedly increased CO_2^+ and $C_6H_6^+$ signals, indicating the presence of benzenecarboxylic acids. Factor analysis of pyrolysis m.s. data revealed the two main underlying chemical tendencies to be a shift from heteroatomic compounds to hydrocarbon series with increasing rank and a difference in degree of aromaticity corresponding primarily to differences in depositional environment.

47329 Determination of sulphur heterocycles in selected synfuels. Kong, R.C.; Castle, R.N.; Iwao, M.; Lee, M.L.; Pratap, R.; Thompson, R.D.; Tominaya, Y. (Department of Chemistry, Brigham Young University, Provo, UT). *Fuel;* **63**: No. 5, 702-708(May 1984).

A fractionation method for isolating the polycyclic aromatic sulphur heterocycles from complex mixtures of polycyclic aromatic compounds was evaluated with respect to recovery for selected standard compounds. It was found that recovery varied from 0 to 70% depending on the structure of the compound. Although quantitative recovery for all components was not obtained, isolation of the sulphur heterocycle fractions has allowed the identification of many new sulphur compounds previously not identified in coal liquids and shale oils. Capillary column gas chromatography with flame photometric detection and mass spectrometry were used for the identification of individual sulphur heterocycles.

47330 (CE-Trans—8009) Use of combined thermoanalytical techniques for coal analysis. Cardillo, P. Translated from *Rivista dei Combustibili ;* **34**: No. 4-5, 129-137(Apr-May 1980). 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84901821. DE84901821

The growing importance of coal has resulted in a renewed interest in the numerous analytical methods normally used for coal and coal products. Many relatively new approaches, based on modern instrumentation, have been shown to be applicable to coal analysis, but have not yet obtained the status of standards. The initial attempts at coal analysis using commercial instruments are concerned with approximate analysis and determination of the calorific value. Thermogravimetric analysis (TGA) is a logical alternative for proximate analysis as is differential scanning calorimetry (DSC) for determining the calorific value. In this paper the data obtained with certain coals are compared with the standard ASTM methods and with the Mettler TA 2000 C thermoanalyser. The results are in excellent agreement, both as regards proximate analysis and as regards calorific value. 5 references, 9 figures, 4 tables.

0108 Waste Management

REFER ALSO TO CITATION(S) 01080047410, 47757, 48578

47331 (CONF-8306126—4) Reclaiming orphaned lands using a pneumatic backfill process. Juntunen, R.; Hiel, M.; Mundie, B. 1983. 12p. NTIS, PC A02/MF A01. File Number DE85900082.

From American Society of Agricultural Engineers summer meeting; Bozeman, MT, USA (26 Jun 1983).

ASAE Paper No. 83-2035.

Pneumatic conveyance systems of varying capabilities were used to backfill abandoned coal mines. Results indicate that pneumatic conveyance of backfill materials is a viable method of abandoned mine reclamation. Costs are competitive especially when the alternatives of offsite disposal areas and relocating structures and roadways are considered. Pneumatic stowage can be used to: (1) dispose of toxic, barren coal waste piles, (2) permanently seal mine openings, (3) abate surface subsidence. 3 references, 3 figures, 1 table.

47332 (CSIRO-DFF-IR—142) Comparative environmental impact of methods for the disposal of coal washery tailings with particular reference to fluidized bed combustion. Duffy, G.J.; Kable, J.W. 1984. 72p. Commonwealth Scientific and Industrial Research Organization, Div. of Fossil Fuel, North Ryde.

This report considers the environmental impact of the fluidized bed combustion process as a means for treating and disposing of coal washery wastes relative to current disposal methods. It concentrates largely on the problem of treating the finer, high moisture content tailing fraction of the wastes produced by washeries. It is assumed that most of the coarse refuse and the ash products from the fluidized bed combustion process would be disposed of in embankments close to the washery. Fluidized bed combustion, through its potential for heat recovery and electricity generation, offers the possibility of producing income from the treatment of tailings. In this study no significant adverse environmental consequences that would add to the cost of implementation of the process were identified.

47333 (DOE/ET/15492—T56) Laboratory/bench scale testing and evaluation of A.P.T. Dry Plate Scrubber. Eighteenth quarterly report, June 1, 1984-August 31, 1984. 28 Sep 1984. Contract AC21-80ET15492. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85002077.

The objective of this project is to conduct a bench scale experimental evaluation of the dry plate scrubber (DPS) at high temperature and pressure to determine its potential for controlling particulate and alkali vapor emissions from PFBC processes. This project is divided into two phases and eight major tasks as listed in Table 1. Phase I is a preliminary study consisting of a theoretical review, preliminary particle collection experiments and preliminary alkali sorption experiments. The purpose of Phase I was to provide specific design criteria for Phase II. Phase II is a bench scale evaluation of the DPS at high temperature (900°C) and pressure (1000 kPa). The bench scale DPS has been designed and evaluated for both particulate matter and alkali vapor control. A detailed process design of a DPS sub-pilot plant installed at a PFBC facility is being made. The process economics will be evaluated in terms of capital and operating costs as a function of cleaning efficiency. 7 figures, 6 tables.

47334 **(DOE/MC/19196—1654) Technical and economic evaluation of ten high temperature, high pressure particulate cleanup systems for pressurized fluidized bed combustion.** Rubow, L.N.; Borden, M.; Buchanan, T.L.; Cramp, J.A.C.; Fischer, W.H.; Klett, M.G.; Maruvada, S.M.; Nelson, E.T.; Weinstein, R.E.; Zaharchuk, R. (Gilbert/Commonwealth, Reading, PA (USA)). Jul 1984. Contract AM21-82MC19196. 660p. NTIS, PC A99/MF A01; 1; GPO Dep. File Number DE84012004.

The objective of this analysis was to provide a technical and economic evaluation of the ten high temperature, high pressure (HTHP) systems for the purpose of prioritizing them according to performance, cost, and general viability of achieving commercial status. The scope primarily included reviewing/normalizing test experience to date, normalizing commercial designs, developing normalized capital and operating costs for each system, performing trade-off studies, and performing an evaluation utilizing in-house and outside inputs. The HTHP particulate cleanup system must be capable of the same stringent operating requirements as a conventional system, except it must do so at HTHP conditions. Utilities will demand nearly the same reliability as found in conventional equipment. Regarding particulate cleanup, the system must meet NSPS requirements at the stack, and also meet turbine inlet requirements. The ten devices evaluated were: Electrostatic Precipitator - Cottrell Environmental Sciences (CES); Ceramic Felt Filter - Acurex Corporation; Ceramic Cross Flow Filter - Westinghouse; Shallow Static Granular Bed Filter - Ducon/Westinghouse; Electrostatic Granular Bed Filter - General Electric (GE); Moving Granular Bed Filter - Combustion Power Company (CPC); Dry Plate Scrubber - Air Pollution Technology (APT); Magnetic Granular Bed Filter - Exxon; Electrocyclone - General Electric; and Acoustic Agglomerator - Aerojet/Pennsylvania State University (PSU). The test data for the ten devices were normalized to standard conditions with a reference inlet particle loading and size distribution. The purpose of system design normalization is to provide, for each of the HTHP concepts, a scaled-up commercial design which reflects a consistent design approach. 104 figures, 136 tables.

47335 **(DOE/MC/20110—1636) Ceramic fabric material testing.** Chang, R. (Acurex Corp., Mountain View, CA (USA). Energy and Environmental Div.). 29 Jun 1984. Contract AC21-83MC20110. 111p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE84012014.

The objective of this R & D project is to provide rapid testing procedures and associated apparatus that can be used to quantitatively assess appropriate properties of ceramic fabrics. These rapid tests are needed to evaluate ceramic fabric for their potential as bag filter media for hot gas cleanup, comparing various ceramic fabrics in terms of selected performance properties, and ensuring uniformity of the ceramic fabric during the manufacturing process. To facilitate the overall progress of the project, the program is divided into two phases. Phase I shall establish a preliminary list of performance parameters that adequately characterize ceramic fabrics and recommendations as to appropriate rapid test procedures and apparatus required to characterize ceramic fabrics. Phase II shall develop required test apparatus, test sample ceramic fabrics, and provide data analysis and reporting. Contents of this report include the following: (1) program summary; (2) characterizing and specifying filter fabrics; (3) evaluating ceramic filter media potential; (4) preliminary plan for characterization and evaluation of ceramic filter media candidates; and (5) appendices for textile terminoloy and description of specifications and test procedures. 8 references, 12 figures, 14 tables.

47336 **(DOE/OR/03054—71-Vol.2) Wastewater treatment system and solid wastes landfill for 6000 tpd SRC-I Demonstration Plant. Volume 2. Design baseline revision.** (Catalytic, Inc., Philadelphia, PA (USA)). 1984. Contract AC05-78OR03054. 227p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE85001624.

In a description of secondary treatment, topics covered include: process description, process control philosophy, drawing list, material balances, utility summary sheets, equipment list, equipment data sheets, and tabulation of motors. The same information is given for tertiary treatment, sludge treatment, and landfill.

47337 **(DOE/OR/03054—71-Vol.3) Wastewater treatment system and solid wastes landfill for 6000 tpd SRC-I Demonstration Plant. Volume 3. Cost baseline revision.** (Catalytic, Inc., Philadelphia, PA (USA)). 1984. Contract AC05-78OR03054. 126p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85001626.

This volume contains data on individual cost estimates for each of 5 treatment areas. These are then combined for a single, overall estimate of water treatment cost. The cost estimate is based primarily on process equipment. Individual prices were established for all pieces of major equipment. (This included mobile equipment). Material take offs were used to establish the cost of large tanks, silos, sumps and earthwork (for the landfill). Instrumentation, piping, and electrical costs were factored, based on major equipment. The building cost was based on a unit area estimate. Home office engineering was based on nine percent of the total cost. The capital costs includes the construction of one landfill cell. The construction of additional landfill cells will be required in the future (approximately one per year). This cost has been estimated separately and is treated as an operating cost.

47338 **(DOE/OR/03054—83) 6000 tpd SRC-I Demonstration Plant, gas systems, phenol recovery system, non-proprietary version: design baseline package.** 14 Nov 1983. Contract AC05-78OR03054. 306p. NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE85001615.

Detailed process descriptions, including process flow diagrams, process unit balance sheets, equipment design factors and data sheets, and a cost estimate summary of a phenol recovery system are presented. The purpose of the phenol recovery system is to remove and recover phenolic compounds from sour waters originated from the SRC coker/calciner and the Expanded Bed Hydrocracker (EBH) areas. A Chem-Pro Corporation proprietary process is used. The process was originally developed by Jones & Laughlin Steel Corporation to remove phenol from coke oven waste waters and has a twenty year history of operation in that service. In the process, the phenol compounds are removed from the aqueous feed by countercurrent extraction into a solvent. The nearly phenol-free raffinate is steam stripped to remove and recover dissolved solvent thereby producing a discharge water acceptably low in both phenol and solvent content. The extract is distilled to separate the solvent from the phenolics. The solvent is recycled to the extractor and the phenolics become a process by-product. Design feed flow rates and compositions for various conditions are listed. In addition, the phenolic compounds are specified to be composed of 62% monohydric phenol, 23% cresols and 15% resorcinol. The discharge waste water is to contain no more than 50 mg/l of phenol as a compound nor 60 mg/l total phenolics. However, to meet the total phenolics specification, the residual phenolics in the waste water will be nearly all resorcinol with only 3 or 4 mg/l of phenol as a compound because the resorcinol is so much more difficult than phenol to extract with the solvent.

47339 **(DOE/PC/60271—3) Modelling and assessment of advanced processes for integrated environmental control of coal-fired power plants. Technical progress report.** Barrett, J.G.; Bloyd, C.N.; McMichael, F.C.; Rubin, E.S. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Center for Energy and Environmental Studies). Jul 1984. Contract FG22-83PC60271. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE84016280.

The key objective of this research is the development of a computer based model for the assessment of integrated environmental control (IEC) systems for conventional and advanced coal fired power plant designs. Efforts during the period April 1-June 30, 1984 focused on, (1) testing of a preliminary integrated model linking pre-combustion and post-combustion control options for conventional plants; (2) documentation of the analytical models of existing control technology options; (3) development and preliminary testing of a second model design for the propagation and analysis of uncertainty; and (4) development of new analytical models needed for IEC assessments. Activities and accomplishments in each of these areas are described. 4 references, 13 figures, 4 tables.

47340 **(EPRI-CS—3636) Reliability assessment of particulate control systems. Research Project 1401-1. Final report.** Goldbrunner, P.; Von Kaenal, A.; Lagomarsino, J. (Burns and Roe, Inc., Oradell, NJ (USA)). Aug 1984. 313p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920018.

The objective of this report is to quantify the capability of modern high efficiency particulate control systems to reliably control fly ash emissions from pulverized-coal-fired utility boilers. Included is the development of a data base on the major factors influencing the reliability of electrostatic precipitators (ESPs), baghouses, and the related fly ash removal equipment. The operating and maintenance histories of 38 electrostatic precipitator (ESP) installations and 7 baghouse installations, at 19 generating stations, having 13,222 MW generating capacity, are summarized in this report. The analysis of ESP installations, addresses, major ESP design parameters, ESP performance, and O and M problems experienced by each major ESP subsystem are included. Comparisons of the performance and O and M experience of hot side and cold side precipitators and rigid frame and weighted wire designs are also presented. The report includes the analyses of baghouse installations, addresses, baghouse design, baghouse performance and baghouse operating and maintenance experience. Detailed reports of design, performance, and operating and maintenance experience are presented for each of the ESP and baghouse installations. 100 figures, 49 tables.

47341 **(EPRI-EA—3674) Application of analytic methods: environmental control R and D planning model. Model description and user's manual. Research Project 2040. Final report.** Borison, A.B.; Froker, D.R.; Morris, P.A. (Applied Decision Analysis, Inc., Menlo Park, CA (USA)). Aug 1984. 93p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920047.

The goal of this project was to develop and transfer a usable, interactive computer model to aid in R and D planning and portfolio selection in the general area of environmental control hardware. The Environmental Control R and D Planning (ECRP) Model is an interactive computer model designed to help managers in EPRI's Environmental Control Systems Department evaluate the consequences of different R and D strategies. This two part report describes the model and how to use it. The first part is a multi-level description of the model, designed for both technical and non-technical readers. The second part, printed on the grey pages, is a User's Manual that describes the input and output options. 13 figures, 13 tables.

47342 **(EUR—8875-DE) Beneficiation of cooler condensates and flushing liquors in coking plants (Report on ECSC contract 7220-EB/109).** Eisenhut, W.; Langer, E.; Meyer, C. (Commission of the European Communities, Luxembourg). 1983. 41p. (In German). European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

The use of fractionating condensation to produce the largest possible volume of water with a low pollutant concentration for use as process water, was investigated. An experimental plant was constructed at the Minister Stein coking plant with two coolers in series. The results showed that fractionating condensation combined with aeration and de-phenolization can produce water with a low content of volatile pollutants, but the concentration of fixed ammonium salts is still too high for it to be used as process water.

47343 **(EUR—8876-DE) Conversion of unpurified coke-oven gas in a oscillator tube (Report on ECSC contract 7220-EB/114).** (Commission of the European Communities, Luxembourg). 1983. 22p. (In German). European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

An oscillator tube for a throughput of 1000 m/SUP/3/h of unpurified gas was successfully operated at the experimental coking plant of the Bergbau-Forschung GmbH. Design modifications improved the reliability of the system to such an extent that it is now capable of operating over several weeks.

47344 **(LMF—107, pp 372-376) Potential health and environmental effects of the fluidized bed combustion of coal. Final report.** Seiler, F.A.; Hobbs, C.H.; Cuddihy, R.G. Dec 1983. NTIS, PC A21/MF A01. File Number TI84012996.

In Inhalation Toxicology Research Institute annual report, October 1, 1982-September 30, 1983.

The potential health and environmental risks for a coal combustion technology based on fluidized bed combustion are summarized. The largest impacts are projected in the environment, because of emissions of CO_2 and acid precursors. A major benefit would be the reduction in the emission of acid precursors because fluidized bed combustors (FBC) produce significantly less than conventional combustors. Few human health effects are projected from effluents of an FBC industry, but significant occupational and public risks are related to its operation.

47345 **(PB—84-199868) Application of the dual alkali process at a 280 MW coal-fired power plant. Report for March 1979-May 1981.** Kaplan, N. Jun 1984. 36p. (EPA/600—D-84/145). NTIS, PC A03/MF A01.

The paper gives results of applying the dual alkali (D/A) flue gas resulfurization (FGD) process to a 280-MW coal-fired power plant. (NOTE: D/A is a generic term applied to FGD systems that use soluble alkali to absorb SO2 and then react the spent scrubber solution with lime and/or limestone to regenerate the alkali and produce a waste calcium-sulfur salt for disposal. Features that distinguish D/A from conventional direct lime and limestone scrubbing include: (1) use of a clear solution, rather than a slurry, for contacting the flue gas in the absorber; and (2) reaction of the solution in a separate absorbent regeneration section to form the waste solids, rather than forming the waste solids as a part of the scrubbing operation.) The FGD system met all acceptance test process guarantees except filter cake properties (averaging 52.2 of a minimum required 55 wt% insoluble solids). The remaining guarantees were: SO2 emissions limit, particulate matter emissions, lime consumption, soda ash consumption, power consumption, and system availability. The demonstration started on May 1, 1980, and ended on May 31, 1981.

47346 **(PB—84-199900) Control technology assessment for coal gasification and liquefaction processes, Dravo Corporation, Pittsburgh, Pennsylvania.** Evans, J.M.; Telesca, D.R. 1979. 13p. NTIS, PC A02/MF A01.

Control technology development for the design of synthetic fuel facilities was assessed at Dravo Corporation (SIC-1211), Pittsburgh, Pennsylvania, on April 4, 1979. Dravo, an architectural and engineering company, designed and built facilities for the synthetic fuels industry. The design philosophy stated by Dravo incorporated the concept that facilities processing or producing toxic materials must be designed to totally eliminate emissions. Their procedure consisted of careful attention to proper design concepts, coupled with up to date maintenance, safety, operating, and hygiene programs. Their objective was accomplished by intensive search to find existing operating designs for the desired process. These designs were then evaluated for overall suitability. The authors conclude that appropriate technology exists for handling waste streams; however, mechanical problems within the operating coal conversion facility are still under evaluation. There are also areas of control technology that will need further improvement. These areas are subject to resolution by engineering design and demonstration using commercially available components.

47347 **(PB—84-201359) Assessment of the RP 300 beach cleaner.** Morris, P.R. (Warren Spring Lab., Stevenage (UK)). 1983. 17p. (LR—472(OP)-M). NTIS, PC E03/MF E03.

Plant and Equipment Hire (London) Ltd are the sole UK and an overseas distributor of the RP 300 beach cleaner, which is designed to collect flotsam and holiday litter off sandy amenity beaches and can be towed by most agricultural tractors. The equipment is based on the use of an endless steel belt fitted with rows of sprung tines which rake the beach in the direction it is being towed. The beach cleaner was tested on Pendine sands in November 1983 to assess its ability to rake up and lift small tarry lumps, sometimes called tar balls. The lumps are the final residue washed up onto the beach from the remains of oil spills at sea.

47348 **(PB—84-201532) Evaluation of oil spill dispersant concentrates for beach cleaning.** Crowley, S.; Nightingale, J. (Warren Spring Lab., Stevenage (UK)). 1983. 19p. (LR—463(OP)-M). NTIS, PC E03/MF E03.

An account is given of trials in which a number of dispersant concentrates were assessed for their effectiveness in dispersing medium fuel oil and medium fuel oil mousse from a beach. Subjective comparisons were made using a hydrocarbon base dispersant as reference. Some of the dispersant concentrates performed exceptionally well, offering a more efficient, and in some cases, cheaper alternative to the hydrocarbon base dispersant commonly used at present for cleaning up oiled beaches.

47349 **(PB—84-201706) Low-NOx burners for pulverized-coal-fired boilers in Japan. Report for 3 May 1984.** Ando, J.; Mobley, J.D. (Chuo Univ., Tokyo (Japan)). Jun 1984. 17p. NTIS, PC A02/MF A01.

Presented at FGD Pilot Study Group of the NATO Committee on the Challenges of Modern Society, York, England, 30 May-1 June 1984.

The paper describes nitrogen oxide (NOx) abatement by low-NOx burners (LNBs) and combustion modification (CM) for dry-bottom pulverized-coal-fired boilers in Japan. LNBs have been widely used in Japan as a simple way to reduce NOx emissions by 20-50%. NOx abatement by a LNB and CM is much less costly than by flue gas treatment, primarily because of relatively low operating costs. Even when selective catalytic reduction (SCR) of NOx is applied for extensive NOx abatement, it is generally more economical to use a LNB and CM with SCR than to use only SCR. Possible problems with a LNB and CM for coal-fired boilers include increased unburned carbon, slag formation, and tube wastage.

47350 **(TVA/PUB—84/76) Characterization, treatment, and disposal of liquid and solid wastes from coal gasification facilitites. Volume 1.** Wyatt, J.M.; Cox, D.B.; Woosley, L.H. (Tennessee Valley Authority, Chattanooga (USA). Div. of Water Resources). Jun 1980. 121p. NTIS, PC A06/MF A01. File Number DE85900071.

This report presents information which was used as source material for the assessment of environmental impacts which might be anticipated at either of two sites (Murphy Hill and Courtland) under study by TVA for the location of a coal gasification plant. The information presented in Volume I of this report is not site-specific, but rather discusses the general regulatory perspective pertaining to liquid effluents and disposal of solid wastes from a coal gasification plant, the characteristics of liquid effluents and solid wastes generated in a coal gasification plant, alternative treatment control technologies and disposal options, and an assessment of techniques and procedures for determining appropriate controls to prevent adverse impacts to the water and land environment from the discharge of treated wastes. Volume II presents detailed, site-specific information pertaining to water quality and use at both Murphy Hill and Courtland sites. Several gasification and gas processing technologies have been evaluated in this report and updates have been made on the rapidly changing regulatory aspects of the emerging synfuels industry. 137 references, 6 figures, 37 tables.

47351 **(DOE/METC—84-26-Vol.3-Pt.2) Failure mode analysis for lime/limestone FGD systems. Volume 3. Plant profiles. Part 2.** Kenney, S.M.; Rosenberg, H.S.; Nilsson, L.I.O.; Oxley, J.H. (Battelle Columbus Labs., OH (USA)). Aug 1984. Contract AT02-80CH92122. 586p. NTIS, PC A25/MF A01; 1; GPO Dep. File Number DE85001294.

Plant profiles are given for the following plants: Tombigbee 2, 3; Apache 2, 3; Cholla 1, 2; Four Corners 1, 2, 3; Laramie River 1; Green 1, 2; Duck Creek 1; Craig 1, 2; Conesville 5, 6; Coal Creek 1, 2; Elrama 1, 2, 3, 4; and Phillips 1, 2, 3, 4, 5, 6. (DLC)

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REFER ALSO TO CITATION(S) 01090047331, 47332, 47350, 47380, 48497, 48578

47352 **(BEOP—26) National coal research programme - status report of the programme 'Air pollution due to the emission from coal fired installations'.** (Netherlands Energy Research Foundation, Petten). Apr 1984. 141p. (In Dutch). Nederlands Energy Research Foundation, Petten.

The goal of the National Coal Research Programme is the elimination of barriers to the reintroduction of coal in the Netherlands. The programme 'Air pollution due to the emission of coal fired installations' (Dutch abbreviation LUK) was initiated. The aim of LUK is the collection of quantitative data enabling evaluation of the consequences of coal burning for the various air pollution levels. Eleven projects are carried out by government research institutions and the University of Amsterdam. The costs of the programme amount to 5.8 million guilders, to which the National Coal Research Programme contributes 4.8 million guilders. The main programme accounts for about 75%, the development programme for about 25%. The attention of the programme has been focussed on estimates and measurements of background levels of air pollution and of wet deposition, and on sampling around a coal fired electricity generating plant. A model could satisfactorily describe the relation between the behaviour of the plume and the emissions of the power plant. Flue gas desulfurization is not taken into account. It is doubtful whether an input of 20 million tons of coal a year will ever be realized. The present consumption, largely by utilities, is 4 million tons a year. The estimates are therefore likely pessimistic. During an evaluation meeting the importance of research into effects on organisms and materials on the basis of these results was emphasized. The chemical form of the components is crucial in this respect. In the development programme good results were achieved in the drafting of models (plumes, washout, dry deposition). The study of the behaviour of organic compounds was made difficult by the imperfections in the sampling and analysis techniques. By now these have been largely overcome. The final conclusion is that the coordinated multi-disciplinary approach within this programme proved to be efficient and stimulating.

47353 **(CONF-8306126—1) Native vegetation responses to temporary supplemental irrigation.** Young, S.A. (Montana State Univ., Bozeman (USA)). 1983. 18p. NTIS, PC A02/MF A01. File Number DE85900079.

From American Society of Agricultural Engineers summer meeting; Bozeman, MT, USA (26 Jun 1983).

Results of irrigating either one, two, or three months demonstrated that season of seeding could be extended. Warm-season grass species composition was greater on summer seeded plots and cool-season grass species composition increased with duration of irrigation. Temporary, supplemental irrigation is a viable reclamation tool. 22 references, 5 tables.

47354 **(CONF-8306126—2) Amendments and overburden placement for minesoil productivity reclamation.** Hanson, R.G.; Tucker, M.; Coble, A.D. (Missouri Univ., Columbia (USA)). 1983. 25p. NTIS, PC A02/MF A01. File Number DE85900080.

From American Society of Agricultural Engineers summer meeting; Bozeman, MT, USA (26 Jun 1983).

ASAE Paper No. 83-2140.

The 1977 Federal Surface Mining Control and Reclamation Act was passed to establish a balance among protection of the environment, maintaining agricultural productivity, and the need for coal as an essential source of energy. This research was undertaken to: (a) evaluate glacial till as a plant growth material for restoring productivity; (b) evaluate routine soil tests to predict fertility status of disturbed land; (c) evaluate grass and grass-legume mixtures for reclamation of productivity; and (d) compare water plant filter sludge with agricultural lime for acid minesoil amendment. Glacial till required only P fertilization to restore production of tall fescue, tall fescue plus birdsfoot trefoil, and orchardgrass plus birdsfoot trefoil to the level of production representative of an undisturbed soil. Relative yield, within each forage group, was calculated by using the average of the top 25% individual plot yields as maximum yield. Maximum relative yield of tall fescue was obtained at Bray II soil available P level of 100 ppM P and orchardgrass with 80 ppM P. Fertilizer P requirement necessary to increase the Bray II available P level to the level of maximum yield can be calculated. Productivity of the minesoil was not returned to the level of undisturbed soil during the 2 years of this study. A water plant filter sludge (93.7% $CaCO_3$ equivalent <200 mesh) was more effective in the short term reduction in minesoil acidity than was agricultural lime. Use of the Woodruff buffer system would underestimate potential acidity of recently exposed minesoil, but did adequately measure neutralizable acidity after 12 months of atmosphere and biological exposure. Results from this research point out the importance of material selection for covering the acidic coal overburden to insure a high level of success in returning the productivity of disturbed soil to near that of similar undisturbed soil. 17 references, 6 figures, 4 tables.

47355 **(CONF-8306126—5) Soil erosion potential of reclaimed mined lands.** Hartley, D.M.; Schuman, G.E. 1983. 22p. NTIS, PC A02/MF A01. File Number DE85900088.

From American Society of Agricultural Engineers summer meeting; Bozeman, MT, USA (26 Jun 1983).

Runoff and erosion from three mulch treatments was measured on a surface coal mine near Hanna, Wyoming. Treatments included no mulch, standing grain mulch and crimped straw mulch. Treatments were subjected to artificial rainfall generated by a portable rainfall simulator during three successive growing seasons. The first set of rainfall events was made after imposition of the mulch treatments, the second set was made during the summer following autumn seeding of all treatments with a perennial grass seed mixture and the final set of runs was made 18 months after perennial seeding. Soil loss data indicate a peak in erosion risk during the summer following perennial seeding on the mulched treatments. Soil losses were generally lowest on the straw mulch and highest on the no mulch treatments although soil loss differences declined by the third season. Temporal variation in soil losses as well as soil loss differences between treatments are correlated with ground cover variations. Runoff data indicate a general decline in infiltration rates on all treatments during the study period. Vegetation, soil loss and runoff data were used to calibrate a runoff and erosion computer simulation model. Computer simulation results indicate low amounts of soil loss even for very infrequent, intense, one hour design storms on moderate slopes regardless of mulching method. Simulations indicate that erosion risks are highly dependent upon antecedent soil moisture conditions and the time distribution of storm intensities. 14 references, 4 figures, 5 tables.

47356 **(CONF-8306126—6) Interactive mine reclamation programs for the pocket computer.** Scott, M.D.; Green, O.D. 1983. 12p. NTIS, PC A02/MF A01. File Number DE85900083.

From American Society of Agricultural Engineers summer meeting; Bozeman, MT, USA (26 Jun 1983).

The pocket computer offers the advantages of being inexpensive, portable, and readily available. By modularizing programs under the control of a program executive, large interactive programs can be handled by these machines. The DRAG program for calculating spoils grading volumes at dragline mines is an example of this technique. 4 references, 8 figures, 1 table.

47357 **(CONF-8306126—8) Reclamation of abandoned mines in West Virginia.** Dove, J.L. 1983. 6p. NTIS, PC A02/MF A01. File Number DE85900092.

From American Society of Agricultural Engineers summer meeting; Bozeman, MT, USA (26 Jun 1983).

Reclamation of abandoned mine lands in West Virginia involves disturbed areas from both surface and deep mining activities. Reclamation of deep mine lands deal with mine waste piles and mine openings. Reclamation of surface mine lands involves shaping and grading material to obtain a stable slope and installing water management practices.

47358 **(CONF-8306126—9) Infiltration characteristics of some minespoils at Wabamun Lake, Alberta.** Doram, D.R.; Din, N.U.; Maule, C. (Transalta Utilities Corp., Calgary, Alberta (Canada)). 1983. 20p. NTIS, PC A02/MF A01. File Number DE85900090.

From American Society of Agricultural Engineers summer meeting; Bozeman, MT, USA (26 Jun 1983).

ASAE Paper No. 83-2144.

Infiltration measurements were undertaken on in situ soils, capped and uncapped sodic minespoils at the Highvale mine. The data suggested that capped sodic minespoils have lower final infiltration rates than in situ non-Solonetzic soils, but higher than in situ Solonetzic soils (Natriborolls). The benefits of topsoiling minespoils was also discussed. 14 references, 5 figures, 4 tables.

47359 **(CONF-8306126—10) Interrill erosion as an index of mined land soil erodibility.** Lang, K.J.; Schroeder, S.A.; Prunty, L.D.; Disrud, L.D. (North Dakota State Univ., Fargo (USA)). 1983. 19p. NTIS, PC A02/MF A01. File Number DE85900089.

From American Society of Agricultural Engineers summer meeting; Bozeman, MT, USA (26 Jun 1983).

A rainfall simulation technique was used to evaluate the influence of slope steepness, mulch rate and antecedent soil moisture on runoff, splash, soil loss in runoff and the primary particle size composition of soil in splash and sediment from interrill areas on two western North Dakota mined land soils. 21 references, 4 figures, 4 tables.

47360 **(CONF-8306126—11) Landscape design versus approximate original contour in Missouri.** Vories, K.C.; Coble, A.D.; Krogman, J.M. 1983. 20p. NTIS, PC A02/MF A01. File Number DE85900093.

From American Society of Agricultural Engineers summer meeting; Bozeman, MT, USA (26 Jun 1983).

Integration of the mine plan and reclamation plan has been accomplished at the Prairie Hill Mine. The result has been reduced topsoil handling and a system of large flat farm units separated by tree covered slopes that minimize overburden rehandling and maximize post-mining land value. The detailed analysis of pre-mining overburden, soils, land use, and mine design options has facilitated a practical mitigation of mining effects on the environment, while insuring cost effective utilization of mining and reclamation equipment. Innovations include an alternative to approximate original contour, substitution of overburden materials for prime farmland subsoil, and rearrangement of landscape features to increase post-mining land value. 7 figures.

47361 **(NERDDP-CS—83-10) Environmental aspects of liquid fuels production from coal: prospective research activities, consultancy study No. 10. Study to identify prospective research activities in relation to the assessment of environmental aspects of producing liquid fuels from coal in Australia.** 1983. 166p. National Energy Research, Development and Demonstration Council, Canberra, Australia.

Dames and Moore has undertaken a study aimed at identifying prospective research activities in relation to the assessment of the environmental impacts of producing liquid fuels from coal in Australia. This is the final report of the study. It in turn discusses the study approach, the process technology involved, the potential environmental pollutants, the identified areas of research significance and finally outlines suggested research programmes covering each of these areas.

47362 **(PB—84-189562) Evaluation of mine seals constructed in 1967 at Elkins, Randolph County, West Virginia. Report of investigations/1984.** Adams, L.M.; Lipscomb, J.R. 1984. 37p. (BM-RI—8852). NTIS, PC A03/MF A01.

Library of Congress catalog card No. 83-600300.

In 1980, the Bureau of Mines surveyed a group of mine seals in Randolph County, WV, to evaluate their effectiveness for reducing toxic pollutants in mine water discharges. The survey focused on 11 block wet mine seals, but mine seals of several other types were also examined. The seals were designed to prevent air from entering the mine portals while allowing mine water to flow out. It was believed that by preventing air from entering inactive or abandoned mines, the formation of toxic pollutants and acid mine drainage (AMD) could be reduced.

47363 (PB—84-197094) Effect of physical and chemical factors on the corrosivity of a synthetic mine water. Higginson, A. (Council for Mineral Technology, Randburg (South Africa)). 30 Apr 1984. 29p. (MINTEK-M—140). NTIS, PC E04/MF E01.

An investigation is reported in which the corrosivity of a synthetic mine water (based on samples of machine water) on mild steel was measured by laboratory techniques involving loss in mass, the extrapolation of Tafel plots, and polarization resistance. The effects on corrosivity of systematic variation in important properties of the water, such as dissolved-oxygen content, pH, flowrate, temperature, and concentration of ammonium ions, are quantified. The results indicate that the rates of two cathodic reduction processes (reduction of dissolved oxygen and evolution of hydrogen) control the corrosion rate of mild steel. The effects on corrosivity of much of the dissolved solids (such as chloride, sulphate, and nitrate ions) and of the total hardness of the water is minimal. This invalidates the use of corrosivity indices based on concentrations of dissolved solids. Details of projected laboratory and field tests on the corrosivity of mine waters are included.

47364 (PB—84-199918) Control technology assessment for coal gasification and liquefaction processes, C.F. Braun and Co., Alhambra, California. Final report. Telesca, D.R. Apr 1982. 17p. NTIS, PC A02/MF A01.

A control technology assessment for the design of synthetic fuel facilities was conducted at C.F. Braun and Company (SIC-1211), Alhambra, California, on September 17, 1981. The company was cognizant of the potentially hazardous components of the coal conversion process. Little or no planning to incorporate controls for occupational health had been done. The process was designed first, then modified to meet existing regulations. Facilities were designed to meet construction and safety standards but had not incorporated health aspects because of a lack of standards regulating worker exposures. The company addressed health related issues at a later stage in the development of the overall gasification system. The author concludes that architectural and engineering firms do not include equipment for occupational health during the conceptual design of facilities for economic reasons. Coal conversion units are designed to meet existing or proposed exposure standards, but have no way of determining synergistic effects of products. Design firms should include existing occupational health standards early in the design phase. Retro-fitting equipment is costly and not necessarily the best means for reducing workplace exposures. Workplace exposure standards for chemicals produced at coal conversion facilities must be determined.

47365 (PB—84-202035) Application of a coal pile drainage model to an industrial/institutional site. Brookman, G.T. Jul 1983. 135p. NTIS, PC A07/MF A01.

The report describes the site selection, field sampling and analysis and mathematical model calibration and verification process used to apply a coal pile drainage model to an industrial/institutional site (e.g., a small storage pile of less than 25 tons). The field program included 10 weeks of monitoring drainage flow, pH, conductivity, precipitation, coal moisture, and pile infiltration rates with the analysis of drainage water for acidity, filterable and nonfilterable residue, sulfate and 10 trace metals. Five storms were sampled ranging from 0.62 inches to 1.59 inches of rain. The pH metal concentrations exceeded NYS Department of Environmental Conservation effluent limitations for Class GA waters before treatment.

0110 Reserves And Exploration

47366 (DOE/IA—0009-2-Vol.2) Joint Peru/United States report on Peru/United States cooperative energy assessment. Volume 2. Annex 1. Aug 1979. 163p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE84011695.

In this report, statistical data on production and consumption and supporting information have been obtained from US Bureau of Mines records supplemented by additional data obtained in Peru. Geologic description and analysis of known areas and of areas having possible future potential have been prepared by the Geological Survey. Petroleum is the principal source of energy. With the completion and operation of the pipeline from northeast Peru across the Andes, Peru has very recently become self-sufficient in petroleum. Eleven separate coal fields are known in Peru; complex structure and high ash content of much of the coal has precluded other than minimal utilization of the coal to date. Some of the coal is of coking quality. Geology of the more promising coal fields is reviewed, but reserves for the future are uncertain because of lack of relevant and adequate data. Various reconnaissance investigations between 1933 and 1972 have been made for uranium. These were almost entirely confined to the more easily accessible parts of western Peru. Although some areas of low-level radioactivity were detected, no deposits of possible economic potential were identified. Potential for geothermal energy, especially in southern Peru, is believed to be present and could be large. No serious investigations of this potential seem to have been made. Field investigations should be started as soon as possible, followed by drilling. The report also includes a section on water needs and a section on energy-related minerals needed in connection with development of new supplies of energy from non-renewable sources. Separate abstracts have been prepared for chapters for inclusion in the Energy Database.

47367 (DOE/IA—0009-2-Vol.2, pp 45-67) Preliminary report on coal deposits of Peru. Olive, W.W.; Hobbs, R.G. Aug 1979. NTIS, PC A08/MF A01. File Number TI84011695.

In Joint Peru/United States report on Peru/United States cooperative energy assessment. Volume 2. Annex 1.

Eleven separate coal fields are known in Peru; complex structure and high ash content of much of the coal has precluded other than minimal utilization of the coal to date. Some coal is of coking quality. The geology of the known coal fields is reviewed, but reserves for the future are uncertain because of lack of relevant and adequate data. The deposits range in age from Late Jurassic to late Tertiary and include coal that ranges in rank from lignite to anthracite. At most localities, particularly in departments south of the Department of Huancavelica, the deposits are generally considerably less than a meter thick, are of limited areal extent, and have little or no economic value. However, in central and northern Peru, coal beds with thicknesses greater than one meter are reported at numerous localities, some of which are sites of formerly active mines or are in areas of active exploration.

47368 (DOE/IA/06316—T2) Republic of Korea/United States cooperative energy assessment. Volume III. Reference reports. Part 1 of 3 parts. (Argonne National Lab., IL (USA)). Sep 1981. Contract W-31-109-ENG-38;AI01-78IA06316. 268p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE84011647.

In this report, statistical data on production and consumption and supporting information were obtained from US Bureau of Mines records, supplemented by additional data obtained in South Korea. Geologic descriptions and analyses of known areas and of areas having future potential have been prepared by the Geological Survey. The Republic of Korea does not produce sufficient energy from indigenous resources to meet its energy demands. More than 50 percent of the energy in the Republic is produced from petroleum, most of which is imported as crude and is refined in-country. Domestically produced coal supplies about 32% of the energy demand, and hydroelectric power, about 4%. Other sources include the recently completed Kori-I nuclear powerplant and small amounts from firewood, charcoal, and dung. South Korea's government program stresses construction of additional hydroelectric power installations, increased production of coal, initiation of energy production by additional atomic reactors, and energy savings through conservation as immediate measures to offset use of imported petroleum; onshore and offshore exploration for petroleum and natural gas, development of geothermal potential, and generation of energy by tidal power are stressed as long-range measures. Separate abstracts have been prepared for each assessment (coal, petroleum, uranium, thorium, geothermal, water, and energy related metal and mineral resources) for inclusion in the Energy Database. (DMC)

47369 (DOE/IA/06316—T2, pp A1-A100) **Coal in the Republic of Korea.** Miller, R.L.; Wade, L.V. Sep 1981. NTIS, PC A12/MF A01. File Number TI84011647.

In Republic of Korea/United States cooperative energy assessment. Volume III. Reference reports. Part 1 of 3 parts.

This chapter describes the coal deposits and the mining practices, appraises the current resources, reserves, and production, attempts to assess the future, and offers recommendations directed toward increasing the reserves of coal and toward improving mining efficiency and productivity. Unlike many coal-producing countries, South Korea's known resources of coal are not large, nor is the quality of the coal good. There are 15 producing coal fields each of which are described with particular emphasis on those having the greatest current production and reserves. Most of the anthracite beds are relatively thin, dip steeply from the surface outcrop downward with numerous faults and folds in most of the fields. Because of the intense deformation, coal beds have been subjected to slipping and slicing causing the coal to be thinned or squeezed out of areas of greatest stress. In addition to the anthracite deposits, there are two sizeable areas of lignite-bearing sediments which are being mined at 6 separate sites. The rank and the quality of the coal are determined by the heat value of the coal and range from lignite (3300 cal/Kg) to high volatile bituminous (6600 cal/Kg) to anthracite (8000 cal/Kg). Coal is produced by the Federal Government or by private industry. Total production of anthracite in 1979 was 18,208,000 metric tons (production by field has been tabulated). About 88% of the anthracite produced is used for space heating and cooking and is transported by rail or truck. Total recoverable proved reserves are estimated to be 116,389,000 metric tons. Exploration and mining technologies are described. 18 references, 29 figures, 45 tables. (DMC)

47370 (DOE/IA/06316—T3, pp B.1-B.11) **Coal in Portugal.** Spencer, F.D. Sep 1981. NTIS, PC A07/MF A01. File Number TI84011696.

In Portugal/United States Cooperative Energy Assessment. Volume III. Reference reports, Part 1 of 3 parts.

Estimated original and remaining coal resources of Portugal are small. Coal has been reported in at least 16 areas and has been produced from 9 mines or mining areas. One mine is presently in operation. Since 1894 mines have depleted the reserves about 40%. Individual summary records are not available for coal tonnages mined, lost in mining, and remaining as reserves or resources for Portugal, but based on estimates at only three fields, potential resources of coal of all ranks total at least 76,000,000 metric tons(t). Most coal in Portugal has been classified as anthracite or lignite. Most coal beds in Portugal are steeply dipping and are of Carboniferous (Pennsylvanian) and Permian or Mesozoic (Jurassic and Cretaceous) age. Generally the beds and associated strata are enfolded between older sedimentary rocks of Paleozoic age or are in fault contact with crystalline and/or metacrystalline rocks of Precambrian age. Coal basins generally are narrow elongate synclines having steeply inclined flanks, therefore, the coal resources are restricted in outcrop and are difficult to mine economically by methods that are normally applicable. Coal mining in structural settings similar to those of Portugal's coal fields cannot be accomplished by conventional methods used for mining most flat-lying to nearly flat lying coal beds. Extraction is difficult and mechanized mining methods generally cannot be used. The lack of large known or proven reserves hinders securing necessary finances for normal coal mining and extraction methods. The quality of the coal deposits is genrally poor, and the energy return per unit of coal produced is low; therefore, the cost of the energy return is low and cost of the energy utilitized is high. 1 figure, 4 tables.

47371 **(DOE/LC/10855—T1) Geophysical logs, lithologic descriptions, and coal analyses from coal test holes drilled in 1982 in the Salt Wells and Kemmerer areas, Sweetwater and Uinta Counties, Wyoming. Report of investigations No. 24.** McClurg, J.M.; Gardner, J.D.; Boresi, A.P.; Borgman, L.E. (Wyoming Univ., Laramie (USA)). 1983. Contract AS20-81LC10855. 130p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85000317.

Forty-one coal test holes were drilled in the Salt Wells area, Sweetwater County, Wyoming and ten coal test holes in the Kemmerer area, Uinta County, Wyoming. Both areas are located in southwestern Wyoming. Preliminary results of the drilling, coring, geophysical logging, and the analytical laboratory work on coal samples from the cores are presented. All drill hole locations are described by legal locations (section, township, range) and by distances, in feet, from section lines. Many of the drill holes in the Salt Wells area have also been described by the State Plane Coordinate System. Conventional rotary drilling equipment was used for all drilling and coring operations. The original copies of the geophysical logs were photographically reduced to a scale of 1 inch equals 50 feet for convenience in reproducing this report.

47372 (INIS-mf—9065, pp 112-115) **Field trial of a pair production gauge for the on-line determination of ash in coal.** Millen, M.J.; Rafter, P.T.; Ellis, W.K.; Sowerby, B.D. (Commonwealth Scientific and Industrial Research Organization, Lucas Heights (Australia). Div. of Mineral Physics); Howells, E.; McLennan, T.; Muldoon, L. (Broken Hill Proprietary Ltd., Newcastle (Australia)). Nov 1983. NTIS (US Sales Only), PC A10/MF A01. File Number TI84780622. (CONF-8311183—).

From 3. Australian conference on nuclear techniques of analysis; Lucas Heights, Australia (1 Nov 1983).

The ash content of coal can be determined by a method based on pair production. Coal is irradiated with high energy gamma-rays and 0.511 MeV annihilation and Compton scattered gamma-rays measured. Earlier laboratory tests on 50 kg samples of high ash coals gave errors of 0.46 to 1.3 wt% ash. A plant test to assess the pair production gauge for direct on-line conveyor belt analysis is described. This test was carried out on a recirculating coal loop at a Broken Hill Pty. Ltd. coal washery pilot plant. Samples were measured on-belt as a function of sample depth, compaction, moisture and particle size. The technique was found to provide accurate measurements of the ash content of coal in a constant geometry. It can be used to determine ash content of coal of thickness 60-220 mm on a conveyor belt by an additional measurement of the weight per unit area of coal on the belt by γ-ray transmission.

47373 (N—84-23963) **Coal occurrence, quality and resource assessment, National Petroleum Reserve in Alaska.** Stricker, G.D. (Geological Survey, Washington, DC (USA)). 1983. 2p. NTIS, PC A04/MF A01.

Field studies of the Cretaceous Torok, Kukpowruk, and Corwin Formations in the western portion of the NPRA (National Petroleum Reserve in Alaska) and Cretaceos Torok, Tuktu, Grandstand, and Chandler Formations in the eastern portion of NPRA indicate that two major delta systems are responsible for most of the coal accumulation in this area. The Corwin delta in the western portion was an early Albian to Cenomanian, north and east prograding system, whereas the slightly younger mid-Albian to Cenomanian Umiat delta system prograded north and northeast in the eastern portion. Investigations of the lightologies, fossils, and primary depositional structures of these formations indicate that the Corwin system was deposited as a large, high-constructional, shaped delta on which thick and numerous coals developed on splay and interdistributary bay platforms away from the influence of the Cretaceous epicontinental sea. The Umiat delta started out as a high-constructional system but in time became wave dominated, and its shape changed to lobate.

47374 **(NERDDP-EG—83-177) Sedimentologic control of overburden, Morandah coal measures, Northern Bowen Basin.** Johnson, P. 1983. 97p. National Energy Research, Development and Demonstration Council, Canberra, Australia.

Coal measures are sedimentary rocks and many characteristics of both the coal and surrounding sediments are determined by inherent sedimentary factors. Sedimentologic studies of coal measures are important in both exploration and mining. Increasing exploration and mining of Gondwana coal will be assisted by better understanding of their detailed sedimentology. To augment understanding of Gondwana coal this study considers such areas as depositional history, diagenetic history and weathering history. The study indicates several ways in which sedimentary processes affect the nature of overburden, and also suggests areas where further research would be justified.

47375 **(NERDDP-EG—83-182) Alternative to the traditional method of assessing the coal resource in a geological basin.** Agostini, A. 1983. 102p. National Energy Research, Development and Demonstration Council, Canberra, Australia.

The objective of the study was to develop and assess a methodology as an alternative to only drilling in assessing the coal resource within a geological basin. This alternative methodology was to be such as to minimize the number, and optimize the siting, of drill holes required to determine the coal resource. The study is applied to that part of the Gunnedah Basin in NSW north of the Liverpool Ranges.

0120 Mining

REFER ALSO TO CITATION(S) 01200047362, 47369

47376 **(ACIRL-PR—84-7) New mining methods - single entry. Final report on field trials at Ellalong Colliery.** Wallman, D. 1984. 80p. Australian Coal Industry Research Labs. Ltd., North Ryde.

ACIRL has investigated single entry development in underground coal mines and introduced and demonstrated the method in Australia. Over the duration of the project ACIRL has studied overseas single entry development practice, involved and sought and approval of the NSW Chief Mines Inspector and his department, the Joint Coal Board, the Colliery Managers' Association and the underground coal mining unions, and finally successfully designed and demonstrated the method at an Australian underground coal mine. Four single entry roadways have been driven at Ellalong Colliery, near Cessnock, NSW. The machine used to drive three of the headings was the Dosco In-seam Miner (ISM), leased by ACIRL with the NERDDP funding. The other was driven by a Dosco Dintheader. Part of the project work has been to field test and assess performance of the In Seam Miner which was the first of its kind in Australia.

47377 **(ACIRL-PR—84-8) Geotechnical evaluation of the 'pillar extraction on the advance' system at Tahmoor Colliery.** Skybey, G. 1984. 55p. Australian Coal Industry Research Labs. Ltd., North Ryde.

This report details the results obtained from geotechnical monitoring instruments installed in 101 Panel in A,B,C and D headings, between 11 and 13 cut throughs. C and D headings were developed as pillar in advance especially for this investigation, to determine the magnitude of stress and deformation induced ahead of the pillar extraction face line. The instruments installed consisted of multi-point borehole extensometers, stress cells (both in rib and roof) and floor to floor convergence stations. Unfortunately the majority of convergence stations were lost due to wheeling of shuttle cars destroying floor pins. Instrumentation monitoring was carried out on a weekly basis before extraction, then on a daily basis during the extraction period and on a two weekly basis after the extraction passed the experimental site. The period of monitoring was 135 days. The roof, which consisted of laminated layers of mudstone and shale, up to 10 m thick, produced relatively stable conditions in A heading, the furthest heading from the goaf. However unstable roof conditions were evident in the other three headings adjacent to the goaf. During the monitoring period two intersections required extra support to stop their imminent failure.

47378 **(ACIRL-PR—84-9) Evaluation of pillar stability in development headings at Harrow Creek Trial colliery.** Skybey, G. 1984. 56p. Australian Coal Industry Research Labs. Ltd., North Ryde.

The objective of the work program undertaken at Harrow Creek Trial Colliery was to evaluate the parameters affecting pillar stability in the development panel. The results obtained have been used for the assessment of current roof support systems and pillar design. The work program carried out at Harrow Creek Trial Colliery consisted of: roof rock property determination; coal property testing; strata deformation measurement; coal pillar deformation measurement; Vertical stress measurement; and horizontal stress measurement. The results revealed that the roof consisted of weak immediate strata, composed of finely laminated to very finely laminated silty claystone varying in thickness from 0.5 m to 2.0 m, overlain by much stronger layers of siltstone and sandstone. Roof monitoring results showed that the deformation varied from 2.4 mm in A heading to 16.5 mm in C heading. Side pillar panels were found to have a yielding zone of 5m, while that in the centre pillar panels was 7 m. The respective pillar cores in A and C headings were 13 m and 9 m wide.

47379 **(ACIRL-PR—84-10) Spontaneous combustion of coal, mine fires and interpretation of analyses of mine gases - a literature review.** Cudmore, J.F.; Sanders, R.H. 1984. 60p. Australian Coal Industry Research Labs. Ltd., North Ryde.

This review was undertaken as part of the NERDDP project number 79/9429 'The analysis and interpretation of the gases resulting from heatings, fires and explosions in certain coal mines'. Grantee for the project was The Newcastle Wallsend Coal Company Pty. Ltd., with the Australian Coal Industry Research Laboratories Ltd., (ACIRL) as contractors. The report was published in October, 1983. This report reviews significant published work on the theories, effects and assessment of spontaneous heatings as well as the detection, treatment and interpretation of spontaneous heatings and fires in underground coal mines.

47380 **(CONF-8306126—3) OSM's cone design and installation experience.** Van Dyke, M.W. 29 June 1983. 14p. NTIS, PC A02/MF A01. File Number DE85900081.

From American Society of Agricultural Engineers summer meeting; Bozeman, MT, USA (26 Jun 1983).

The concrete filled steel cone offers an alternative solution in sealing vertical mine shafts. This paper gives the design and installation experiences of the Office of Surface Mining when dealing with abandoned coal mines. This same solution can also be used with other types of shaft closures. 4 figures.

47381 **(DOE/FE/00016—T57) Dust control technology in longwall coal mining. Progress report No. 37, August 1-31, 1984.** Ruggieri, S.K. 20 Sep 1984. Contract AI01-81FE00016. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84017354.

Consistent data-recording intervals offer much greater insight into the mechanics of shield dust than the traditional one-reading-per-movement approach. Based on the upstream-downstream comparisons, it would appear that a significant amount of shield-generated dust does occur, and that a large fraction of the upstream content may in fact be from residual shield dust filtering through the canopy gaps. It appears that the vast majority of respirable dust in the walkway occurs during the set cycle. A large amount of visually impressive nuisance debris is dropped during the drop and advance, however, this does not appear to be as dangerous as the set cycle. Not enough consistent data were collected to ascertain any positive, quantifiable cause and effect relationship between dust and debris accumulation, amounts lost, canopy, and checkplate gaps. The graphical plots, however, are extremely suggestive and the next field visits should incorporate a more intensive examination of these parameters. It may also be instructive to follow the mining sequence throughout a mining day, such that shift to shift variations would be minimized and determinable. The canopy gap water sprays could not be tested due to operational constraint.

47382 **(EUR—8795-FR) Prediction and control of dynamic phenomena (coal and rock bursts) (Report on ECSC contract 7220-AC/309).** Josien, J.P.; Revalor, R. (Commission of the European Communities, Luxembourg). 1984. 123p. (In French). European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

The mechanisms involved in two types of dynamic phenomena (coal bursts in the Provence Group and small induced ejections of rock and gas in the Merlebach Area) were investigated, to help in their detection and prevention. Laboratory work was carried out on the Provence coal and the Merlebach sandstone. Core sampling and exploratory borehole drilling was carried out, and seismoacoustic monitoring of the sounds emitted by the ground was developed to complement the borehole surveillance method. A computer allowed real-time calculation and processing of the parameters of seismoacoustic activity. The use of the C116 FL machine for mechanizing stress-relief borehole drilling has improved working conditions as well as productivity and safety standards in stress-relief working areas.

47383 (EUR—8825-DE) Strata control system (Report on ECSC contract 7220-AC/108). Goetze, W. (Commission of the European Communities, Luxembourg). 1984. 64p. (In German). European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

Working on pre-driven gate roads supported with yielding arches, support methods were developed which enable gate road convergence, which increases with greater depths, to be reduced. Apart from forming the roads in line with or behind the face, this could be achieved by using rapid-setting fill materials and early-bearing packs. Strata bolting was introduced to mechanize support work. In deep coal mining the use of strata bolts is restricted because of their limited yield capacity, so the yielding bolt was developed. Methods were also developed for supporting the face end without reducing the roadway cross-section. This was achieved by employing the backfill and gateside pack technique together with bolts or stringers acting behind the arch supports.

47384 (EUR—8826-FR) Improvement of materials handling and transport from the surface to the working site (with particular reference to very heavy loads) (Report on ECSC contract 7220-AE/304). (Commission of the European Communities, Luxembourg). 1984. 78p. (In French). European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

Although no single solution has been found to the problems of transporting materials, various solutions have been provided by collieries in different areas of France. These include: the introduction of ground-mounted duo-rails of the Streckenkuli or coolie car type and the improvement of equipment for transporting 24 T powered supports; adaptation of equipment for transporting 7 or 13 t chocks from the surface to the face over fairly steep stretches of roadway; modification of the landings and a cage in a service shaft so that heavy equipment can be lowered inside the cage; introduction of a small rubber-tyred vehicle for loading and unloading operations between special transport vehicles and the district vehicles to be mechanized at the district stations; and development of a vehicle hauling a useful load of 15 t and capable of climbing strongly-inclined sections when loaded.

47385 (EUR—8827-EN) Mine roadway floor stabilization (Report on ECSC contract 7220-AE/810). (Commission of the European Communities, Luxembourg). 1984. 64p. European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

Substantial lengths of anhydrite-based mixes were laid underground at High Moor Colliery, UK for evaluation as a running surface for free-steered rubber-tyred vehicles. Technical assistance was provided by Mining Research and Development Establishment. Other work carried out by MRDE included: completion of trials with MBU Grader Compactors (G3 and G5); modification and trials of Dosco Tractor and of Dosco Articulated Grader; development of equipment for use with EIMCO 913 QDS vehicle; investigation into the development of an underground mixer for anhydrite and concrete floor laying; and Selby Mine Tunnel Invert compaction trials.

47386 (EUR—9014-EN) Controlled recirculation of air in mine workings (Report on ECSC contract 7220-AC/810). (Commission of the European Communities, Luxembourg). 1984. 249p. European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

The findings of a preliminary feasibility study into the subject of controlled recirculation of air within main ventilation systems of mine workings are briefly described. Basic theories of recirculation as related to mine airflow quantities and distribution, gaseous pollutants, dust and climatic conditions are outlined and these are related to the mine ventilation system layout. The basic layouts of various recirculation systems are described, and their economics considered. Use of a physical laboratory model is discussed. Case studies, based on computer predictions of the effect of recirculation in two real mine ventilation systems are described in detail. Monitoring and control methods for district recirculation systems are discussed. Factors relating to the impact of recirculation on health and safety in mines are discussed.

47387 (EUR—9040-EN) Application of computer-based environmental monitoring (Report on ECSC contract 7220-AC/807). (Commission of the European Communities, Luxembourg). 1984. 187p. European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

Three NCB mines with substantial but differing underground environmental problems were selected and equipped with computer-based environmental monitoring systems. Each system was based on the MINOS concept of standardized hardware and software specification. The installation of the systems and the operational experience gained are discussed.

47388 (PB—84-186741) System for handling supplies in underground coal mines. Open file report (final) October 1978-April 1983. Chitaley, A.; Diaz, R.A. 22 Apr 1983. 50p. NTIS, PC A03/MF A01.

A new method was developed to handle supplies in underground bituminous coal mines. A survey indicates industry wide implementation potential for the proposed method. Reduction of supply handling accidents by as much as 73% and improvements in the productivity of face operations by at least 3% are anticipated benefits. The new method is based on the palletization of daily supplies and the use of a forklift to carry out the handling tasks at the underground section. The forklift demonstrated several important features necessary for underground supply handling such as compactness, maneuverability, visibility, ease of control and auxiliary attachments for hoisting, carrying timber, and pulling. Design improvements are recommended for future generation underground forklifts that relate to higher speed, increased battery duty cycle, higher payload, and modified traction steering to eliminate plowing of soft mine floors.

47389 (PB—84-189463) Fabrication manual for a reduced-noise auger miner cutting head. Information circular/1984. Pettitt, M.R.; Aljoe, W.W. 1984. 16p. (BM-IC—8971). NTIS, PC A02/MF A01.

Library of Congress catalog card No. 83-600382.

After a long series of laboratory and in-mine tests, a cost-effective, mineworthy, reduced-noise auger miner cutting head was designed, fabricated, and field-tested by Wyle Laboratories under contract to the Bureau of Mines. Compared with standard auger cutting heads, the new heads reduced noise by 10 dBA at the jacksetter's position and by 6 dBA at the operator's position. This report contains detailed fabrication instructions, including engineering drawings, that show how a standard auger cutting head can be modified to produce a reduced-noise auger.

47390 (PB—84-191931) Ground and air vibrations caused by surface blasting. Volume 1. Executive Summary. Open file report (final) 1 October 1980-30 September 1983. Daemen, J.J.K.; Barkley, R.C.; Ghosh, A.; Morlock, C.R.; Shoop, S.A. (Arizona Univ., Tucson (USA). Dept. of Mining and Geological Engineering). Sep 1983. 121p. NTIS, PC A06/MF A01.

See also PB84-191949.

Ground and air vibrations induced by large surface blasts were monitored and the field results, as well as a large number of published results, were used to assess the performance of existing predictors and for the development of improved prediction methods. Field monitoring was performed with four seismographs giving complete wave records at limestone quarries, coal strip mines, and an open pit copper mine. Conventional analysis includes least square fitting of peak particle velocities and peak air overpressures with scaled distance formulations. Frequency content was analyzed and correlated with blast design (detonation sequence). Two new methods were developed to predict ground vibrations induced by blasting. The proposed analytical predictor accounts explicitly for inelastic attenuation and geometrical spreading, and calculates the peak particle velocity as a function of charge weight and distance. Statistical analysis of case studies confirms the consistent improvement over conventional scaled distance predictors. The second new predictor is a computer program simulating blasts including blast geometry, charge distribution, and detonation sequence and simulating propagation of individual pulses to any point of interest where effects are summed. A complete blast vibration results allowing prediction of frequency content and duration as well as peak velocities.

47391 **(PB—84-191949) Ground and air vibrations caused by surface blasting. Volume 2. Ground vibration monitoring and assessment of conventional predictors. Open file report (final) 1 October 1980-30 September 1983.** Shoop, S.A.; Daemen, J.J.K. (Arizona Univ., Tucson (USA). Dept. of Mining and Geological Engineering). Sep 1983. 195p. NTIS, PC A09/MF A01.

See also PB84-191931 and PB84-191956.

Thirty-seven blasts were monitored using either three or four seismographs at four coal strip mines and at a limestone quarry. Statistical analysis of the data shows that square root, cube root, and site specific scaling methods predict peak particle velocities with about the same degree of reliability. Some mines have peak particle velocities that are significantly lower or higher than the Bureau of Mines averages. This suggests that the option provided by the proposed regulations of the Office of Surface Mining in 1983 to adjust blast designs based on site specific measurements could be highly beneficial both to operators and to the public. The frequency spectra reveal that the predominant frequencies were generally less than 50 Hz, but several blasts had a significant amount of energy up to 125 Hz. In some cases the vibration energy was concentrated at frequencies corresponding to the delay intervals.

47392 **(PB—84-191956) Ground and air vibrations caused by surface blasting. Volume 3. Computer simulation predictor of ground vibrations induced by blasting. Open file report (final) 1 October 1980-30 September 1983.** Barkley, R.C.; Daemen, J.J.K. (Arizona Univ., Tucson (USA). Dept. of Mining and Geological Engineering). Sep 1983. 237p. NTIS, PC A11/MF A01.

See also PB84-191949 and PB84-191964.

A computer program was written to simulate ground vibrations induced by multiple-hole surface blasts. The program is an inexpensive and relatively easy to use tool for predicting the principal blast vibration characteristics that determine damage and annoyance potential: peak particle velocity, frequency content, and pulse duration. The program generates a complete ground motion history by superposing, at any surface position, the vibrations induced by each individual explosive charge. It requires specification of and allows accounting for the blast geometry, initiation sequence (including random delays), position with respect to blast, pulse characteristics induced by each charge, and propagation laws. A methodology is outlined to determine the necessary variables either on the basis of site investigations (velocity, attenuation, pulse), or by backcalculation from measured blast vibration records. The latter procedure was applied to blasts from two coal strip mines. It was determined that the main difficulties are backcalculating individual pulses, propagation (especially dispersion) parameters, and delays. It was shown that a normal distribution of delays influences the results and the response of a single degree of freedom structure significantly.

47393 **(PB—84-202662) Performance and test criteria for DC fuses--phase 1. Open-file report 30 September 1982-18 March 1984.** Stanek, E.K.; Wiltanen, D.O. (Michigan Technological Univ., Houghton (USA)). Mar 1984. 177p. NTIS, PC A09/MF A01.

The objective of this research was the development and test criteria for DC fuses used in coal mines. Field tests were conducted in 10 coal mines in which transients were initiated on the DC system from which the parameters of the DC mine electrical power system could be determined. The data processing involved the use of a Fourier analyzer to filter noise and fit an exponential curve to the field waveforms. From this data analysis it was possible to find the DC system resistance, inductance, and time constant. A survey of nationally recognized laboratories was conducted to establish that the recommended test criteria were practical.

47394 **(PB—84-202944) MSHA (Mine Safety and Health Administration) approved mine rescue - training module (coal): surface organization. Mine rescue team series.** 1984. 26p. NTIS, PC A03.

See also PB84-202951.

Mine rescue teams work with a whole network of people, who make all arrangements for setting-up the surface organization. The surface organization consists of authorized personnel, emergency facilities and special services required for an effective rescue and recovery operation. This training module is intended to provide mine rescue teams with background information for organizing a mine rescue and recovery operation. The material describes the activities, tasks and procedures normally carried-out on the surface during an emergency operation.

47395 **(PB—84-202951) MSHA (Mine Safety and Health Administration) approved mine rescue - training module (coal): mine gases. Mine rescue team series.** 1984. 75p. NTIS, PC A04.

See also PB84-202969 and PB84-202944.

Mine rescue teams may have to make tests for gases with permissable gas detectors repeatedly during a rescue and recovery operation. The team's job of gas detection may provide important clues about what happened in the mine and about the potential hazards in the affected area. This training manual is intended to provide teams with important information on mine gases, gas detectors and detection methods after a mine disaster. This module also describes how to identify mine gases, how to test for gases and how to interpret the findings and readings of gas levels.

47396 **(PB—84-202969) MSHA (Mine Safety and Health Administration) approved mine rescue - training module (coal): mine ventilation. Mine rescue team series.** 1984. 67p. NTIS, PC A04.

See also PB84-202977 and PB84-202951.

Mine rescue teams play a critical role in restoring mine ventilation after a disaster. Teams explore inby specifically to assess damages, measure airflow conditions and check damages to ventilation controls. Teams often alter ventilation according to orders from command officials. This training manual is intended to provide teams with background in the purpose, principles and methods of mine ventilation. The manual also covers the mine ventilation map, map symbols and airflow measuring devices.

47397 **(PB—84-202977) MSHA (Mine Safety and Health Administration) approved mine rescue - training module (coal): exploration. Mine rescue team series.** 1984. 71p. NTIS, PC A04.

See also PB84-202985 and PB84-202969.

Mine rescue teams often must conduct basic exploration work after a fire, explosion or inundation. Teams explore the affected area to check on damages, report on local conditions inby, and locate missing miners or clues to their whereabouts. Teams follow recommended and acceptable procedures for exploration that developed over the years out of the mine rescue tradition. This training module is intended to provide teams with a basic understanding of exploration during a rescue and recovery operation. The manual covers the methods, traveling procedures and the importance of progress reporting and simultaneous mapping during exploration.

47398 **(PB—84-202985) MSHA (Mine Safety and Health Administration) approved mine rescue - training module (coal): fires, fire fighting, and explosions. Mine rescue team series.** 1984. 77p. NTIS, PC A05.

See also PB84-202993 and PB84-202977.

Mine rescue teams frequently must fight fires and guard against the propagation of fires or explosions during a rescue and recovery operation. The team's ability to fight fires depends a great deal on hands-on experience with different fire fighting agents and equipment. The team's work includes an assessment of fire conditions, mine fire gases and other potential hazards associated with fire fighting activity. This training module covers the underlying principles of the fire triangle and the different methods for controlling, containing and extinguishing fires in a mine. The manual also covers fire-fighting equipment, considerations involved in a sealing operation and the cause-effect of explosions.

47399 (PB—84-202993) MSHA (Mine Safety ad Health Administration) approved mine rescue - training module (coal): rescue of survivors and recovery of bodies. Mine rescue team series. 1984. 28p. NTIS, PC A03.

See also PB84-203009 and PB84-202985.

Mine rescue teams utilize all of their training skills to locate missing miners during a rescue operation. Teams explore inby to search for, and bring-out survivors after a mine disaster. The teams attempt to evacuate injured and trapped miners safely according to recommended rescue and recovery methods. This training module is intended to provide teams with the proper methods, factors and the numerous considerations in locating possible survivors during a mine emergency. The material also describes the proper methods for opening a barricade, for administering first aid, for handling injured miners, plus the special requirements for recovery of bodies after a mine disaster.

47400 (PB—84-203009) MSHA (Mine Safety and Health Administration) approved mine rescue - training module (coal): mine recovery. Mine rescue team series. 1984. 40p. NTIS, PC A03.

See also PB84-203017 and PB84-202993.

Mine rescue teams often participate directly in the recovery of damaged mine property after a fire, explosion or inundation. The teams use all the skills and knowledge of training in mine recovery work. The teams may be involved in air sampling, restoring ventilation, unsealing operations and rehabilitation of the affected area. This training module is intended to provide mine rescue teams with a background in the specific procedures and methods of mine recovery. This manual provides a general overview of mine recovery methods and procedures, plus a basic explanation of the considerations and factors that may affect the recovery job.

47401 (PB—84-203017) MSHA (Mine Safety and Health Administratin) approved mine rescue - training module (coal): mine rescue activity book. Mine rescue team series. 1984. 61p. NTIS, PC A04.

See also PB84-203009.

The Mine Rescue Activity Book contains suggested activities for the instructor or team trainer to use in conjunction with the Advanced/Refresher Mine Rescue Training Modules. Some activities may help supplement classroom lectures. Other activities include full-scale drills and exercises for mine rescue teams. The Activity Book is intended to assist trainers and instructors in building competent mine rescue teams. The design of activities focuses on both individual skills performance and on the team's ability to work as a cohesive unit during a rescue and recovery.

47402 (SAND—83-1191C) Physical and numerical simulations of subsidence above high extraction coal mines. Sutherland, H.J.; Heckes, A.A.; Taylor, L.M. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1984. Contract AC04-76DP00789. 9p. (CONF-840943—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84008027.

From ISRM symposium on design and performance of underground excavations; Cambridge, UK (3 Sep 1984).

Modeling the failure and settlement of strata above mine openings requires a knowledge of several different geomechanical processes such as the failure of the rock mass above the opening, the fall of this mass into the opening, the associated bulking of the rock rubble, and the recompaction of the rubble under subsequent loading. These processes are studied in this paper using physical models and analytical models. The former are based on centrifuge simulation techniques, and the latter on numerical techniques. The centrifuge experiment described here simulated the response of a shale overburden after being undermined by a long wall panel. This simulation shows progressive failure of the overburden, the formation of a failure arch, and the formation of a subsidence trough. The data from these experiments are analyzed with a numerical analysis scheme called BLOCKS. This model treats the overburden as an assemblage of blocks. The equations of motion for each block are solved using an explicit integration operator. The displacements, rotations and collisions of each block are calculated in the model.

47403 Comparative economics of vertical wells and in-mine boreholes for coal bed methane drainage. Gillies, A.; Gabello, D.P. (TRW Energy Engineering Division). pp 540-549 of Proceedings of the 1981 international gas research conference. Rockville, MD, USA; Government Institutes, Inc. (1982). (CONF-810909—).

From International gas research conference; Los Angeles, CA, USA (28 Sep 1981).

Owners/operators of deep, potentially gassy coal reserves face a choice of initiating a vertical well drainage program many years in advance of mining or conducting an in-mine, horizontal borehole degasification operation in parallel with mining. The vertical well system requires a higher investment and since it is conducted virtually independent of the mining generally must be competitive with other similar investments. When these systems are compared for predrainage of a large longwall mine, the vertical well system can produce a much higher return-oninvestment rate. Since the total coalbed methane produced over the life of each operation is assumed to be the same, the vertical well economic advantage accrues solely from the earlier investments and revenues when considered on a discounted cash flow basis. Longer lead times for vertical wells reduce total investments through increased well spacing and also increase returns when compared on a DCF basis. Owner/operators should determine if predrainage is required and act as early as possible to maximize the returns on their predrainage investments.

47404 (SMRE-Trans—7276-T) Centralised control of coal mine ventilation. Karpov, E.F.; Karpov, D.A.; Birenberg, I.E.; Mester, I.I. (Safety in Mines Research Establishment, Sheffield (UK)). Sep 1977. Translation source information not available . (CONF-7710198—1-Trans.). 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84901844.

From 17. international conference of mining safety research; Varna, Bulgaria (3 Oct 1977).

Basic aspects of centralized control of ventilation in underground coal mines are examined. One suitable type is classified as easily controlled ventilation systems. These are separate ventilation systems each of which contains a draft source, a main ventilation fan, and a distribution network. The air flow rate is maintained by an air flow regulator. For continuous monitoring of methane content a system is used consisting of sensors, signalling devices and a control post for receiving information. The same type of system is used to monitor air speed. The use of these systems in mine No. 8 and the algorithms and programs used to process the information are described.

0130 Transport And Handling

REFER ALSO TO CITATION(S) 01300047270, 47322, 47326, 47384

47405 (CETEM-CT—36) Gravimetric methods of coal beneficiation. Campos, A.R. de. 1981. 26p. (In Portuguese). Centro de Tecnologia Mineral (CETEM), Rio de Janerio, Brazil.

The paper discusses gravimetric methods of coal beneficiation, describing coal characteristics and physical properties, washability studies, particle size distribution, forecasting of beneficiation results using washability curves and various coal beneficiation processes. (In Portuguese)

47406 (DOE/OR/03054—94, pp 321-328) **Chemical cleaning of coal: the Catalytic Heap Leaching Process.** Wetherington, J.B. (Air Products and Chemicals, Inc., Trexlertown, PA). Jun 1984. NTIS, PC A16/MF A01. File Number TI85001630.

In SRC-I technical report, July-December 1983.

An evaluation of the proposed Catalytic Heap Leaching Process (CHLP) for pyrite removal from coal has been completed. Two conclusions were reached based upon a literature investigation and laboratory work designed to answer specific questions crucial to the process. First, based upon a review of the literature and discussions with persons knowledgeable in the field, no evidence has been found to support the theory that bacteria catalyze the oxidation of ferrous ion to ferric ion, the later being the primary oxidizing agent of pyrite in the proposed process. Therefore, there is no requirement for bacterial growth in the coal stack. Secondly, based upon laboratory work, substantial pyrite removal cannot be achieved using 3/4- to 3/64 in. coal at ambient temperature in five days. Only at elevated temperatures ($>$100°C) and for small-particle coal can the design specifications of 95% pyrite removal be met. These findings are supported by the literature. In the author's opinion, the answers obtained are sufficiently definitive to preclude further laboratory work on this specific process. 3 tables.

47407 (DOE/OR/03054—94, pp 329-364) **Chemical and physical cleaning of coal. Part I. An initial review of the literature on the chemical cleaning of coal.** Wetherington, J.B.; Conrad, R.R.; Hart, W.A. (Air Products and Chemicals, Inc., Trexlertown, PA). Jun 1984. NTIS, PC A16/MF A01. File Number TI85001630.

In SRC-I technical report, July-December 1983.

The literature reviewed in this paper covers the chemical cleaning of coal with various reagents for the period 1927 to 1972. References pertaining to the removal of nitrogen, sulfur, and ash from coal were sought for inclusion in this preliminary review. Although not specifically reviewed in this report, references appearing since 1972 have also been collected. 300 references.

47408 **(EPRI-CS—3666) Coal cleaning to improve Illinois No. 6 Seam coal for combustion.** Parkinson, J.; Torak, E. Sep 1984. 172p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920001.

Illinois No. 6 Seam coal from Perry County, Illinois was tested at EPRI's Coal Cleaning Test Facility (CCTF) to see if physical coal cleaning can improve the coal's combustion performance. Union Electric burns this coal at its Labadie Power Station and experiences severe slagging problems that have forced unit derating. Also, low sulfur coal must be blended with the Illinois No. 6 coal to meet SO_2 emission standards of 4.8 lb/MBtu. The CCTF tested 560 tons of Illinois No. 6 Seam coal to: determine the washability characteristics; assess the degree of impurity liberation achievable by roll crushing; compare raw coal and different clean coal qualities; and produce specific quality coals for pilot scale combustion tests (1.5 MBtu/h heat release rate). The Illinois No. 6 Seam coal currently burned at the Labadie Power Station is cleaned by a baum jig process. The jig's average clean coal has a slagging index of 1.24 and SO_2 emission potential of 5.0 lb/MBtu compared with the raw coal's 1.65 slagging index and 6.8 lb SO_2/MBtu. Improved-quality, clean coal was produced at the CCTF with a 0.95 slagging index and 4.5 lb SO_2/MBtu. This clean coal was produced with only a two- to three- percentage point sacrifice in energy recovery from the existing jig process. Comparative combustion tests were conducted on raw, existing, and CCTF-cleaned coal samples. Combustion test results will be published by EPRI in the near future. 14 references, 20 figures, 23 tables.

47409 **(EUR—8874-DE) Optimizing the dewatering of fines produced during coal preparation (Report on ECSC contract 7220-EA/103).** Erdmann, W. (Commission of the European Communities, Luxembourg). 1982. 57p. (In German). European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

The possibility of obviating, or at least minimizing, the use of thermal drying in the dewatering of fines produced during coal preparation was investigated. Particular attention was paid to fines below 0.5 mm. The wobble centrifuge was tested for dewatering washed smalls and was found to give a residual water content below that obtained in a parallel vibrating screen centrifuge, as well as a higher throughput rate. However, the service life of the baskets was short and the solids yield was unsatisfactory. A solid bowl screen centrifuge was developed further so that rate of wear was decreased and reliability increased. Further experiments on the dewatering of flotation concentrate were carried out with the flat-bottom screen centrifuge. The use of screen bowl and pusher centrifuges used in series was found to be suitable, in principle, to the dewatering of fines, but the solids yield was too low. Two horizontal vacuum filters were tested, but these are too large to be incorporated in an existing preparation plant. Extensive laboratory and industrial trials were carried out with different types of reagents that might improve dewatering: all the tensides led to some degree of reduction in water contents, whilst the anionic surface active reagents with high solubility yielded the largest reductions.

47410 **(EUR—9059-FR) Utilization of coal and ore fines (Report on ECSC contract 7220-EC/308).** (Commission of the European Communities, Luxembourg). 1984. 53p. (In French). European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037.

A technique was developed for agglomerating coal and ore fines to produce an ovoid for the manufacture of ferrosilicon in an electric arc furnace. The use of a more homogeneous charge in the furnace makes for improved yield and reduced electricity consumption. The work involved: laboratory development of types of blend having suitable mechanical characteristics after sintering; and, on a semi-industrial plant, optimization of the conditions for agglomerating the various constituents, and optimization of the thermal treatment necessary to achieve the appropriate mechanical characteristics.

0140 Combustion

REFER ALSO TO CITATION(S) 01400047282, 47332, 47334, 47408

47411 **(APAE—2687-5) Case study applications of venture analysis - fluidized bed. Progress report, October 8, 1977-November 4, 1977.** Edwards, J.B. (Energy Resources Co., Inc., Cambridge, MA (USA)). Nov 1977. Contract AC01-77ET15089. 44p. NTIS, PC A03/MF A01; GPO Dep. File Number DE84017609.

The company's plans for questionnaires and interviews with prospective fluidized-bed combustor customers are given and their progress in carrying out these studies is identified. An outline of their final report is given. Some emphasis is given to how a fluidized-bed boiler program could be affected by Government efforts, such as financial incentives, taxes, regulations, demonstration programs, etc. The study considers problems of industrial customers (e.g., paper companies) with large process steam requirements and those of boiler manufacturers (13 are listed). The major effort is an attempt to evaluate the potential AFBC market, based to some extent on the present inventory of boilers in the US. (LTN)

47412 **(BNL—35057) Coal/water fuels in America's energy future.** Sapienza, R.; Krishna, C.; Butcher, T.; Marnell, P. (Brookhaven National Lab., Upton, NY (USA)). Jun 1984. Contract AC02-76CH00016. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85001346.

Coal-water slurry fuels is one of the most exciting energy development in recent years. This synthetic fuel has generated enormous interest from many diverse groups. Coal in a liquid form has properties which will allow it to be handled and burned in equipment designed for petroleum fuels. Further, it can be made available at a cost comparable to present fuel costs. Coal-water slurry fuels can accomplish this without incurring the high capital costs involved in the conversion of coals to synfuels or with the conversion of industrial plants to handle solid coal fuel. Within this simple concept, however, many technological approaches with varied application have come forth. Our objective in this paper is to overview this field and suggest options for the utilization of coal-water slurry fuels in America's future.

47413 **(DOE/FC/10614—T9) Fundamental combustion studies of low-rank coal slurries. Quarterly technical progress report No. 2, June 1, 1984 to August 31, 1984.** Germane, G.J.; Smoot, L.D. 15 Sep 1984. Contract AC18-84FC10614. 36p. NTIS, PC A03/MF A01; GPO Dep. File Number DE84017562.

This contract for fundamental combustion studies of low-rank coal slurries was initiated March 1, 1984. Slurries to be studied will be primarily those produced from steam-dried lignite coal provided by the Grand Forks Project Office. Contract work includes virgin coal and slurry characterization, slurry spray and atomization measurements, detailed mapping of combustion products and pollutants for low-rank coal slurries in a laboratory reactor, and comparison of results with computer model predictions and data obtained under similar conditions from combustion of high-rank coal-water mixtures. Accomplishments for this quarter are presented for the following tasks: (1) coal and coal-water mixture (CWM) characterization; (2) CWM reactor; and (3) atomization/combustion of slurries. 12 references, 15 figures, 2 tables.

47414 **(DOE/PC/60801—T3) Combustion of calcium-exchanged coal. Third quarterly report.** Gavalas, G.R.; Flagan, R.C. (California Inst. of Tech., Pasadena (USA). Dept. of Chemical Engineering). 21 Aug 1984. Contract FG22-83PC60801. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84016294.

During the third quarterly period of this project experimental work continued in the entrained flow combustion of calcium-exchanged coal at temperatures representative of pulverized combustion. The experiments included variation of the reactor wall temperature and the oxygen content in an effort to confirm that SO_2 recombination with O_2 and CaO to form $CaSO_4$ in the colder parts of the furnace constitutes the basic mechanism of sulfur capture. In parallel with the experiments calculations were carried out using a particle combustion model to calculate the particle temperature and assess the possibility of calcium vaporization. 4 figures.

47415 **(PB—84-209485) Kinetic studies related to the LIMB (Limestone Injection Multistage Burner) burner. Final report February 1982-May 1984.** Attar, A. (North Carolina State Univ., Raleigh (USA). Dept. of Chemical Engineering). Jun 1984. 323p. NTIS, PC A14/MF A01.

The report gives results of theoretical and experimental studies of subjects related to the Limestone Injection Multistage Burner (LIMB). The main findings include data on the rate of evolution of H2S from different coals and on the dependence of the rate of evolution on the distribution of organic sulfur functionalities in the coal. A method was developed for determining the pore structure of solids at high temperatures which also allows estimates of the diffusion and adsorption coefficient of the gases onto the solid surface using the pulse dispersion method (PDM) and Fourier analysis. The method was applied to the sintering of lime. In addition, the PDM was used to determine the influence of sulfation on the diffusion of gases into lime. Several other studies were conducted, including analyzing the influence of ash composition on ash fusion temperature and developing new correlations for their estimate. The surface forces on coal and how they affect the adherence of minerals to the surface were determined. Also, the rates of reduction of iron pyrite and doped iron pyrite by hydrogen were measured. A comprehensive survey of the chemistry and kinetics of the various reactions which occur in LIMB is presented, along with new findings.

47416 **Adsorption of NaCl and KCl on Al_2O_3 at 800 to 900°C.** Luthra, K.L.; LeBlanc, O.H. Jr. (General Electric Corp., Schenectady, NY). *Journal of Physical Chemistry;* **88**: No. 9, 1896-1901(26 Apr 1984). Contract AC21-79ET15490.

Adsorption was observed by measuring the weights of microporous alumina adsorbents as a function of time while they were exposed to varying partial pressures of NaCl and KCl in a stream of Ar. Despite the high experimental temperatures, the results exhibited the characteristics of physical adsorption. Adsorption and desorption were reversible without hysteresis. The kinetics appeared to be limited by transport through the adsorbent pores. The steady-state weight gains were readily described by the BET isotherm. The values of the weight gains at monolayer coverage, deduced from both the steady state and the rate data, were of the size expected from the adsorbent surface areas and estimated molecular cross sections. The phenomenon promises to be useful for removing trace amounts of these corrosive salts from hot combustion gases.

0150 Marketing And Economics

REFER ALSO TO CITATION(S) 01500047245, 47291, 47433

47417 **(IEA/CREAS—84/09) International steam coal trade: a summary comparison of the Atlantic and Pacific markets.** Gaskin, M. Dec 1983. 25p. (EAS-G—5/83). NTIS, PC $50.00.

See also IEA/CREAS-84/04. Prepared in cooperation with Aberdeen Univ. (Scotland).

This summary report uses both of the reports below to show the similarities and contrasts between the two regional coal trading systems and to see what picture of the world trade emerges. New information is introduced that has a bearing on the comparisons. See Also: IEA/CREAS-84/04 and IEA/CREAS-84/07.

0160 Health And Safety

REFER ALSO TO CITATION(S) 01600047344, 47379, 47382, 47386, 47403, 47976

47418 **(DOE/PC/62999—3) Exploratory research on mutagenic activity of coal-related materials using statistical evaluation.** (Cincinnati Univ., OH (USA). Dept. of Environmental Health). 1984. Contract AC22-83PC62999. 23p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84017382.

Variations of standard Salmonella mutagenicity assays were examined for their applicability in the identification of biologically active HPLC fractions of coal-related materials. A final concentration of 1% Aroclor S9 is most suitable for screening of fuel samples in the forward mutation assay using TM677. Two hours incubation is optimal for assay of fuel samples. A reverse mutation assay for TA97 and TA98 incorporating suspension incubation was investigated. Results are somewhat variable. A 60-minute incubation is most suitable for assay for coal-related materials. 10 figures.

02 PETROLEUM

0201 Reserves

47419 (DOE/IA—0009-2-Vol.2, pp 11-44) **Summary of Peru's hydrocarbon potential, estimated reserves, and projected production rates.** Matrick, R.E.; Yenne, K.A. Aug 1979. NTIS, PC A08/MF A01. File Number TI84011695.

In Joint Peru/United States report on Peru/United States cooperative energy assessment. Volume 2. Annex 1.

Petroleum is the principal source of energy in Peru and with the completion of a pipeline from northeast Peru across the Andes, Peru is now self-sufficient in petroleum. New oil and gas fields must be found, however, to replace dwindling supplies from older fields, and to provide any surplus for export. The geologic setting of known oilfields is reviewed and figures for estimated reserves are cited. In general, Peru is believed to have large additional potential for oil and gas, particularly in the jungle east of the Andes, but exploration for and development of new oilfields will be difficult, expensive, and time-consuming. In the 1975 to 1976 period a combination of negative exploration results in the Amazon basins and shortcomings in the Peruvian formula for foreign participation in petroleum development led to an exodus of most foreign companies. This has caused exploration for new fields to all but cease. As a result, future production rates are expected to peak in about 1981 and, thereafter, to decline rapidly. The Peruvian government, therefore, is trying to attract foreign oil companies into exploratory ventures on more favorable terms and has recently opened up vast areas for service contracts. These include about 25 million offshore acres on the Pacific continental shelf and 1175 million acres in the Amazon region. From discussions with officials of Petroleos del Peru and foreign oil companies operating in Peru, the authors estimate that the total of Peru's measured, indicated, and inferred reserves of oil are about 1095 million bbl. If new exploratory ventures to locate undiscovered oil deposits are not initiated, we expect Peru's oil production to peak at about 81.9 million bbl/yr in 1981, level off at about 70 million bbl/yr in the middle 1980's, and then rapidly decline to about 10 to 15 million bbl/yr in the year 2000.

47420 **(DOE/IA/06316—T3) Portugal/United States Cooperative Energy Assessment. Volume III. Reference reports, Part 1 of 3 parts.** (Argonne National Lab., IL (USA); Geological Survey, Reston, VA (USA)). Sep 1981. Contract W-31-109-ENG-38;AI01-78IA06316. 135p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE84011696.

In this report, statistical data on production and consumption and supporting information were obtained from US Bureau of Mines records supplemented by additional data obtained in Portugal. Geologic descriptions and analysis of known areas and of areas having possible future potential have been prepared by the US Geological Survey. Approximately 80% of Portugal's electric energy is produced by hydroelectric stations; thermal stations produce the other 20%. Portugal has produced no crude oil, natural gas, or condensate; no resources or reserves in these categories are listed for Portugal in the 1976 World Energy Conference report. Production of coal in Portugal has declined steadily to the present annual yield of about 200,000 metric tons. On the basis of estimates in only three coal fields, resources of coal of all ranks in Portugal total at least 76 million (10^6) metric tons. Uranium is mined near Viseu and Guarda in the northern part of Portugal; the Nisa mine in east-central Portugal will begin producing uranium ore in 1985 after installation of a processing plant. Geothermal energy has not been developed in mainland Portugal; however, hot springs that may have geothermal energy potential are known in the Minho district in the northwest. Portugal's best prospect for near-future development of additional energy resources appears to be in the hydroelectric sector. Separate abstracts have been prepared for each chapter. (DMC)

47421 **(N—84-23938) Speculations on the petroleum resources of Antarctica.** Behrendt, J.C.; Masters, C.D. (Geological Survey, Washington, DC (USA)). 1983. 2p. NTIS, PC A04/MF A01.

Information on potential petroleum resources in Antarctica is summarized as follows: (1) west Antarctica is probably the most prospective area of Antarctica because is likely contains large areas of unmetamorphosed sedimentary rock of post-rift age; (2) the only practical areas for possible exploitation, were petroleum to exist, are the continental margins; (3) the sparse geophysical data suggest that there is a thick section of sedimentary rock beneath the Ross and beneath the Weddell Sea continental shelves; (4) DSDP holes on the Ross Sea continental shelf indicate the presence of rocks from Oligocene to Pleistocene in age; (5) there is presently no direct information on the petroleum geology beneath Antarctic continental shelves relative to source and reservoir rocks; and (6) Programs of environmental research are necessary to study meteorological, glaciological, oceanographic, and geologic hazards encountered during exploration or exploitation. Research programs into the fragile ecosystems that might be affected by possible blowouts or oil spills would also be required.

47422 **(N—84-23960) Oil and gas resources of the North Slope, Alaska.** Bird, K.J. (Geological Survey, Washington, DC (USA)). 1983. 4p. NTIS, PC A04/MF A01.

After 40 years of oil and as exploration by Government and industry, the North Slope is now known to contain resources of both conventional and unconventional oil and gas. Conventional oil is currently the only economic resource, but an important one that contributes one-fifth of daily U.S. production. Unconventional oil resources include heavy oil, tar, and oil shale. Unconventional gas resources include tight-gas sand, gas hydrates, coalbed methane, and geopressured methane. The current understanding of these resources is based on two Government exploration programs, combined with information from U.S. Geological Survey (USGS) onshore and offshore studies, the literature, and industry drilling results.

0202 Geology And Exploration

REFER ALSO TO CITATION(S) 02020047366, 47368, 47419

47423 (DOE/IA/06316—T2, pp B1-B18) **Petroleum geology of the continental shelf beneath the East China Sea and the Korea Strait, Korea.** Fisher, M.A.; Yenne, K.A. Sep 1981. NTIS, PC A12/MF A01. File Number TI84011647.

In Republic of Korea/United States cooperative energy assessment. Volume III. Reference reports. Part 1 of 3 parts.

Beneath the East China Sea, the dominant regional structures are north-east-trending ridges and basins that extend from Taiwan to near Japan and that appear to be fault-bounded blocks of continental crust. Two basins, the Taiwan basin and Okinawa trough, are as much as 6 to 8 km deep and contain strata that may contain petroleum resources. Strata in the basins are probably Miocene and younger, and we infer that strata in the Taiwan basin were deposited in shallow-marine and nonmarine environments and that strata in the Okinawa trough were deposited in a marine environment that was deeper than the environment of the Taiwan basin. Consequences of these differing environments are that reservoir rocks may have satisfactory characteristics and be more abundant in the Taiwan basin than in the Okinawa trough, but that source rocks are more likely to be present in the trough than in the basin. In our opinion, the major question to be resolved is whether adequate source rocks for petroleum are present offshore. We believe that the Okinawa trough has a higher potential to contain oil than the Taiwan basin has. Estimates of recoverable reserves of oil and gas are presented. 18 references, 6 figures.

47424 (DOE/IA/06316—T3, pp A.1-A.29) **Petroleum potential of Portugal.** Ball, M.; Carter, R.; Younse, G. Sep 1981. NTIS, PC A07/MF A01. File Number TI84011696.

In Portugal/United States Cooperative Energy Assessment. Volume III. Reference reports, Part 1 of 3 parts.

The report reviews Portugal's petroleum position with respect to the history of exploration, regional geology, petroleum geology, and the outlook following the latest phase of exploratory drilling. Because of unsuccessful exploration efforts to date, we conclude that it is unrealistic to hope that future exploration efforts will solve Portugal's energy problems. Despite the fact that the cadre of workers involved are most capable and competent, the level of the government's effort in analyzing existing data and developing information that could interest oil companies in another cycle of petroleum exploration is inadequate. The effort is small in terms of the amounts of data to be examined. It is small in terms of the great capital investment made in the drilling and in acquiring the existing geophysical measurements. Finally, it is especially small relative to the cost of imported oil. As industry activity at present is nearly nil, government must fill the gap. Expansion of this effort seems to be justified. 34 references, 12 figures, 3 tables.

47425 **(DOE/METC/SP—210) Arctic and Offshore Research Subprogram: Reducing the uncertainties about producing oil and gas in the Alaskan Arctic.** Oct 1983. 36p. NTIS, PC A03/MF A01; GPO Dep. File Number DE84009250.

In assessing the research. The needs for the Arctic and Offshore Research (AOR) Subprogram, Morgantown Energy Technology Center with the DOE Fossil Energy Office of Oil, Gas, and Shale Technology, developed a 5-year plan that includes the following activities: (1) AOR data base development and coordination; (2) ice research; (3) seafloor soils research; and (4) subice arctic research. The DOE Arctic and Offshore Research Subprogram was initiated in FY 83, the major programming activities were performed in January and February 1983, and the program evolved to its present form by the conclusion of FY 83. The current program activities have included determining the various Arctic bibliographic data bases and initiating most pieces of the research described above (except multi-year ice properties, pipeline research, and subice feasibility studies. The seismic-measurements study continues the work initiated by the Energy Research and Development Administration, updated with an Arctic emphasis. The FY 83 accomplishments include redesigning the seafloor earthquake measurements system (SEMS) and assessing the preliminary Alaska site for potential SEMS deployment. 1 reference, 1 figure, 9 tables.

47426 **(N—84-23961) Petroleum source rock richness, type and maturity for four rock units on the Alaskan North Slope: are they sources for the two oil types.** Magoon, L.B.; Claypool, G.E. (Geological Survey, Washington, DC (USA)). 1983. 2p. NTIS, PC A04/MF A01.

A comprehensive petroleum geochemical study assessed the petroleum resources on the Alaskan North Slope. The collection and interpretation of geochemical data not only from exploratory wells drilled in the National Petroleum Reserve in Alaska (NPRA) but also from wells drilled to the east in the Prudhoe Bay area and from rocks exposed in the Arctic National Wildlife Refuge and in the Brooks Range from Cape Lisburne to the United States/Canadian border were studied. More than 17 different kinds of rock analyses, eight different oil analyses, and three gas analyses are being used to evaluate rock (outcrop samples, core, drill cuttings), oil (seeps, drill stem test, oil-stained core, producing well), and gas (drill stem test, producing well) samples on the North Slope. To date, the more than 60,000 analyses completed on these samples were placed into a computer-based file for storage and retrieval in tabular, graphical, or map form numerous graphical software programs were written to facilitate interpretation.

47427 (N—84-23972) **Geochemical detection of prospective petroleum areas in Arctic regions.** Roberts, A.A.; Donovan, T.J.; Hendricks, J.D.; Cunningham, K.I. (Geological Survey, Washington, DC (USA)). 1983. 1p. NTIS, PC A04/MF A01.

Geochemical prospecting for petroleum is based on the premise that microseepage of compounds from oil and gas reservoirs does occur and that these compounds subsequently migrate to the Earth's surface. These techniques involve the detection of epigenetic alteration of near-surface rocks due to the presence of these seeping hydrocarbons, or the detection of alterations of the chemical composition of the near-surface soils and soil gases themselves. Two geochemical exploration techniques that were developd for use in the continguous United States were investigated for their applicability in the permafrost environment of the Arctic coastal plain. The first of these involves the detection of anomalously high concentrations of the noble gas helium in near-surface permafrost. The second technique involves the detection of anomalous shallow-subsurface occurrences of magnetic minerals through the use of low-altitude (90 m), special purpose, aeromagnetic surveys.

47428 (USGS-PP—1294) **Future supply of oil and gas from the Gulf of Mexico.** Attanasi, E.D.; Haynes, J.L. (Geological Survey, Reston, VA (USA)). 1983. 25p. GPO. File Number TI84901774.

Appraisals of oil and gas resources, which are typically presented in terms of proved and undiscovered categories, generally do not provide information on the costs of finding and (or) developing the resources. A model for integrating predictions from a discovery process model to estimate incremental costs of finding and producing undiscovered oil and gas resources (as of January 1, 1977) is presented and applied to the offshore Gulf of Mexico. Incremental finding and development costs were estimated separately for the Miocene-Pliocene trend (47,500 mi^2) and the Pleistocene trend (12,978 mi^2). An estimated 9.47 billion barrels of oil and 94.28 trillion cubic feet of gas or 25.19 billion barrels of oil equivalent (BOE) are contained in fields discovered prior to 1977 in the Gulf of Mexico. The application of the model indicated that, at $35 per BOE (in 1981 dollars) and an after-tax rate of return of 15%, an estimated 4.80 billion barrels could be economically discovered and developed. At $50 per BOE, the estimated discoverable oil and gas amounts to 6.78 billion BOE. However, these quantities represent only 19 and 27% of the 25.19 billion barrels discovered before 1977. These results indicate the mature state of exploration in the offshore Gulf of Mexico in areas of water depths of 656 feet or less. Analysis of the results indicates that drilling two to three wildcat wells in the Miocene-Piocene trend for every well drilled in the pleistocene trend will continue to be economically optimal. Results of the analysis also indicate that, if past trends continue, 71% of the hydrocarbon resources discovered after January 1, 1977, will be in the form of nonassociated natural gas. Crude oil is expected to account for only about 17% of the hydrocarbons discovered. Natural gas liquids, from nonassociated gas fields, are expected to amount to about 39% of the amount of crude oil recovered. 8 references, 9 figures, 17 tables.

0203 Drilling And Production

REFER ALSO TO CITATION(S) 02030047440, 47726

47429 (DOE/BC/10095—19) **Mobility control and scaleup for chemical flooding. Annual report, October 1981-September 1982.** Pope, G.A. (Texas Univ., Austin (USA). Dept. of Petroleum Engineering). Nov 1984. Contract AC19-79BC10095. 295p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE85000103.

The ongoing objectives of this project are: (1) to determine quantitatively the effects of dispersion, relative permeabilities, apparent viscosity and inaccessible pore volume on micellar/polymer flooding, and (2) to develop numerical simulators which incorporate these and other features of the process, so that mobility control design and scaleup of the micellar/polymer flooding process can be better accomplished. Section 2 of this report includes the results for capillary desaturation experiments for low tension fluids in Berea. These results show that some residual brine remains during microemulsion flooding even at the highest capillary number obtained in this experiment. Section 2 also includes more extensive results from the dispersion and relative permeability experiments. This section also includes data which extends the dispersion and relative permeability results from the case of two-phase flow to include initial results of three-phase flow at steady state. Section 3 is a complete description of our updated simulator. Section 4 describes and gives the results of an oil recovery experiment. Section 5 compares the results of this oil recovery experiment with our simulator. The agreement is the best obtained so far. Section 6 compares our simulator with a Sloss experiment reported by Gupta. Again, the agreement is good and demonstrates the capability of the improved simulator to account for the separation of alcohol and surfactant. Section 7 contains the results of several 2-D areal simulations involving new features of the 2-D simulator reported last year. Section 8 is a list of some of the major conclusions of this simulation research. Section 9 is an SPE paper combining the results of Senol with Walsh, a Ph.D. student of Lake and Schechter. Her polymer experiments were interpreted using Walsh's geochemical simulator. 133 references, 118 figures, 21 tables.

47430 (DOE/BC/10327—20) **Development and verification of simplified prediction models for enhanced oil recovery applications. CO_2 (miscible flood) predictive model. Final report.** Paul, G.W. Oct 1984. Contract AC19-80BC10327. 127p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE84012729.

A screening model for CO_2 miscible flooding has been developed consisting of a reservoir model for oil rate and recovery and an economic model. The reservoir model includes the effects of viscous fingering, reservoir heterogeneity, gravity segregation and areal sweep. The economic model includes methods to calculate various profitability indices, the windfall profits tax, and provides for CO_2 recycle. The model is applicable to secondary or tertiary floods, and to solvent slug or WAG processes. The model does not require detailed oil-CO_2 PVT data for execution, and is limited to five-spot patterns. A pattern schedule may be specified to allow economic calculations for an entire project to be made. Models of similar architecture have been developed for steam drive, in-situ combustion, surfactant-polymer flooding, polymer flooding and waterflooding. 36 references, 41 figures, 4 tables.

47431 (DOE/ET/12044—55) **Micellar-polymer joint demonstration project, Wilmington Field, California. Final report.** Newman, R.H.; Aguey, O.J.; Staub, H.L. Nov 1984. Contract AC03-76ET12044. 65p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85000104.

The micellar-polymer flood described here is Marathon Oil Company's Maraflood (TM) process and was designed by Marathon after much laboratory and field testing. The project was cosponsored with DOE and the City of Long Beach with the goal of unconsolidated oil sands typical of the California region. The test pattern selected, after conducting several computer model studies, is a staggered line drive consisting of four injection wells and six producing wells, with all injectors backed up by a North-South trending fault. The sand selected for this pilot is located in the watered-out area of the Hxa sand of the Upper Terminal V-B Pool. The pilot project includes a total oil sand volume of 580 acre-feet underlying an area of about ten acres with an average net sand thickness of 58 feet (17.7 M). The permeability to air is about 400 Md. The residual oil saturation after water flooding was estimated to be 37.4%. Cumulative oil produced during the pilot as of 10-31-82 is 190,785 bbls. (30,333 m^3). 80% of the oil produced was due to response from the chemical injection with the remaining 20% attributed to infield drilling of the producers in the pilot area. Significantly high operating costs were incurred during the operation of the pilot. Severe corrosion problems were encountered which required major remedial work in several of the producers. 14 references, 17 figures, 5 tables.

47432 **(PB—84-214436) Short term projections of offshore petroleum and natural gas production and costs. Final report March 1983-May 1984.** Morra, F. Jr.; Peth, S. 30 May 1984. 127p. NTIS, PC A07/MF A01.

A data base on Lower-48 oil and natural gas production by field was constructed. The data were validated by comparison with aggregate independent sources for cumulative production, remaining reserves, inferred reserves, and distribution of fields. Production from these fields was extrapolated to the Year 2010. 34 newly discovered fields were analyzed to investigate trends in cost. In addition to the data, methodological advances were made in the estimation of inferred reserves, creation of typical production curves for offshore fields, the relationship between field size, field area and well productivity, and the engineering costs of offshore fields. A model of the costs of offshore gas transmission pipelines was developed.

0206 Health And Safety

47433 **(ANL/CNSV-TM—143) Regional energy price projections.** Gaines. L.L. (Argonne National Lab., IL (USA)). Feb 1984. Contract W-31-109-ENG-38. 26p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85001475.

This report projects regional energy prices to the year 2010 for the residential, commercial, and industrial sectors. Biofuels must meet these prices if they are to compete in the fuel market. Energy price projections from the National Energy Policy Plan are regionalized by use of projections published by Data Resources, Inc., for 11 US regions. The resulting projections are consistent with Department of Energy strategic planning and can be updated annually. 7 references, 11 figures, 6 tables.

47434 **(PB—84-199785) Epidemiological study of the incidence of cancer as related to industrial emissions in Contra Costa County, California. Final report September 1978-December 1982.** Austin, D.F.; Nelson, V.E.; Swain, B.E.; Johnson, L.F. Jun 1984. 79p. NTIS, PC A05/MF A01.

The purpose of this study was to examine the relationship of lung cancer incidence in Contra Costa County to ambient levels of air pollution. It was suspected that the presence of heavy industry in the county, mainly petrochemical plants and oil refineries, could be a contributing factor. Initially, an incidence analysis established that the industrial portion of the county had an excess of lung cancer as compared to the remaining non-industrial portion. Air pollution patterns were subsequently determined by five permanent air monitoring stations and ten temporary stations which monitored the levels of 12 air pollutants for a period of one year. By correlating the 1970-79 lung cancer rates for each census tract and tract levels of air pollution constituents, a statistically significant relationship between ambient air SO4 and lung cancer in males, but not in females, was found. However, when adjusted for the percent of the working population categorized as blue collar, the association was eliminated. An interview study of 249 cases and 373 controls was then conducted. Demographic, work history, residential history, dietary, and smoking history questions comprised the bulk of the data collected. Analysis indicated that the major contribution to lung cancer in the county was due to cigarette smoking. No significant association between lung cancer risk and measured constituents of air pollution was found. Of five broad occupational categories (indicating possible hazardous exposures) none had any significant relationship to lung cancer.

0207 Marketing And Economics

REFER ALSO TO CITATION(S) 02070047428, 47430

47435 **(NP—4901337) Outer Continental Shelf Oil and Gas Leasing and Production Program. Annual report, fiscal year 1983.** (Department of the Interior, Washington, DC (USA)). 30 Mar 1984. 64p. NTIS, PC A04/MF A01. File Number DE84901337.

The Annual Report on the Outer continental Shelf (OCS) Oil and Gas Leasing and Production Program for Fiscal Year (FY) 1983 is submitted to the Congress pursuant to section 15(1) of the OCS Lands Act, as amended. This report describes the OCS leasing and production activities during FY 1983, including a summary of receipts and expenditures, and, in compliance with section 22(g) of the Act, also includes information on OCS safety violations submitted by the US Coast Guard. Oil and gas production from the OCS constitutes an important part of the Nation's domestic energy supply. To provide access to possible new sources of oil and gas offshore, the Department of Interior (DOI), through the Minerals Management Service (MMS), conducted eight OCS lease sales during FY 1983, one of which was divided into two parts. Tracts in the Gulf of Mexico (GOM) were offered in three of the sales, including the sale that was held in two parts because of special circumstance involving preparation of the prelease documents. Of the five remaining sales, three were offshore Alaska, and two were in the Mid-Atlantic and South Atlantic. The eight sales resulted in the leasing of 1420 tracts covering 7,493,781 offshore acres. A total of $8,397,804,592 was received in bonus money. First year rentals from the eight sales totaled $22,901,682. On the basis of MMS figures, oil and gas produced on the OCS in FY 1983 amounted to more than 342 million barrels of crude oil and condensate and more than 4.0 trillion cubic feet of natural gas. Federal offshore oil production amounted to 10.8 percent of total US production during FY 1983, while offshore gas amounted to 24.4 percent of total US production. All of the offshore production occurred in the GOM and off southern California. A total of 383 exploratory wells and 588 development wells was drilled on existing leases during FY 1983. 3 figures, 14 tables.

47436 **(WAOENG—84-01) Petroleum supply and distribution systems in Washington State.** Carlisle, D. Jan 1984. 54p. Washington State Energy Office, 400 East Union Ave., Olympia, WA 98504. File Number TI84901919.

Since Washington has no commercially proven indigenous source of crude oil, all of the petroleum used in Washington's seven refineries is imported from Alaska (64%), California or other domestic fields (12%), and foreign countries (24%). Ninety-three percent of this oil is transported by tanker ship into Puget Sound. The aggregate crude capacity of these refineries is 400,000 barrels per day. Stock levels for finished products in 1982 were well below the average range (for the past three years) indicating that trends in inventory management have changed with respect to the change in demand. In 1981, the state consumed 247,000 barrels per day while it produced 324,000 barrels per day of refined products, making Washington a net exporter of petroleum products. Approximately 160,000 barrels per day were exported to Oregon, Alaska, California, and foreign countries. Refined products delivered to Washington averaged 270,000 barrels per day, 64% of which was supplied by Washington State refineries, 7% by foreign imports, and 29% by Utah, California, Montana, and Wyoming refineries. Of the refined products consumed in Washington State, approximately 45% was delivered to Washington by product pipelines originating in Cherry Point, Washington; Salt Lake City, Utah; Billings, Montana; and Casper, Wyoming. The remaining 55% was transported by ship and barge.

0208 Waste Management

47437 **(DOE/BC/10823—6-Vol.1) Recovery of Navy distillate fuel from reclaimed product. Volume I. Technical discussion.** Brinkman, D.W.; Whisman, M.L. Nov 1984. Contract AC03-84BC10823. 178p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85000102.

In an effort to assist the Navy to better utilize its waste hydrocarbons, NIPER, with support from the US Department of Energy, is conducting research designed to ultimately develop a practical technique for converting Reclaimed Product (RP) into specification Naval Distillate Fuel (F-76). The first phase of the project was focused on reviewing the literature and available information from equipment manufacturers. The literature survey has been carefully culled for methodology applicable to the conversion of RP into diesel fuel suitable for Navy use. Based upon the results of this study, a second phase has been developed and outlined in which experiments will be performed to determine the most practical recycling technologies. It is realized that the final selection of one particular technology may be site-specific due to vast differences in RP volume and available facilities. A final phase, if funded, would involve full-scale testing of one of the recommended techniques at a refueling depot. The Phase I investigations are published in two volumes. Volume 1, Technical Discussion, includes the narrative and Appendices I and II. Appendix III, a detailed Literature Review, includes both a narrative portion and an annotated bibliography containing about 800 referenvces and abstracts. This appendix, because of its volume, has been published separately as Volume 2. 18 figures, 4 tables.

47438 **(DOE/BC/10823—6-Vol.2) Recovery of Navy distillate fuel from reclaimed product. Volume II. Literature review.** Brinkman, D.W.; Whisman, M.L. Nov 1984. Contract AC03-84BC10823. 351p. NTIS, PC A16/MF A01; GPO Dep. File Number DE85001797.

In an effort to assist the Navy to better utilize its waste hydrocarbons, NIPER, with support from the US Department of Energy, is conducting research designed to ultimately develop a practical technique for converting Reclaimed Product (RP) into specification Naval Distillate Fuel (F-76). This first phase of the project was focused on reviewing the literature and available information from equipment manufacturers. The literature survey has been carefully culled for methodology applicable to the conversion of RP into diesel fuel suitable for Navy use. Based upon the results of this study, a second phase has been developed and outlined in which experiments will be performed to determine the most practical recycling technologies. It is realized that the final selection of one particular technology may be site-specific due to vast differences in RP volume and available facilities. A final phase, if funded, would involve full-scale testing of one of the recommended techniques at a refueling depot. The Phase I investigations are published in two volumes. Volume 1, Technical Discussion, includes the narrative and Appendices I and II. Appendix III, a detailed Literature Review, includes both a narrative portion and an annotated bibliography containing about 800 references and abstracts. This appendix, because of its volume, has been published separately as Volume 2.

0209 Environmental Aspects

REFER ALSO TO CITATION(S) 02090048497, 48521

47439 **(AD-A—139791/8) Degradation of jet fuel hydrocarbons by aquatic microbial communities. Interim report 23 October 1981-30 September 1983.** Spain, J.C.; Somerville, C.C.; Butler, L.C.; Lee, T.J.; Bourquin, A.W. Nov 1983. 226p. NTIS, PC A11/MF A01.

A model fuel mixture of fifteen hydrocarbons representative of those in distillate jet fuels was used to determine whether degradation by natural microbial communities could affect the persistence of such fuels released into aquatic environments. The mixture included hexane, cyclohexane, n-heptane, methylcyclohexane, toluene, n-octane, ethylcyclohexane, p-xylene, cumene, 1,3,5-trimethylbenzene, indan, naphthalene, 2-methylnaphthalene, n-tetradecane, and 2,3-dimethylnaphthalene. The water-soluble fraction of the model fuel was incubated in shake flasks with water or water and sediment suspensions collected at estuarine and freshwater sites. Surface films of the model mixture were studied under quiescent incubation. The disappearance of hydrocarbons was measured by capillary gas chromatography. Control flasks were sterilized with HgC1 to estimate losses due to abiotic processes. Fate tests were repeated with petroleum-derived JP-4. The soluble components of JP-4 were volatilized too rapidly for biodegradation to occur. Sedimentation dramatically affected the fate of fuel components when mixing of the hydrocarbon and sediment layers was studied. Sediment-associated components were more resistant to volatilization and microbial attack.

47440 **(CONF-8306126—7) Restoration of oil well drilling sites.** Taylor, W.E. 1983. 12p. NTIS, PC A02/MF A01. File Number DE85900091.

From American Society of Agricultural Engineers summer meeting; Bozeman, MT, USA (26 Jun 1983).

ASAE Paper No. 83-2143.

Preservation of topsoil during the construction and backfilling procedures, and conservation of moisture following seeding are the two most important and expensive components of successful restoration. Procedures and costs are given for various probabilities of success. Seeding dates and rates for various plant species are also given. 2 tables.

47441 **(FWS/OBS—82/61) Method for ranking biological habitats in oil spill response planning and impact assessment.** Adams, J.K.; Benkert, K.A.; Keller, C.; White, R. Aug 1984. 50p. NTIS, PC A03/MF A01. File Number TI84901889.

The report describes a method that enables oil spill response planners to minimize the ecological impacts of oil spills by determining protection priorites for biological habitats. The objective of the method is to allow persons responding to an oil spill to quickly identify areas that should be protected first, second, and on to the extent that personnel and equipment are available. The first part of the report describes the rationale and general components of the method. The last part presents an application of the method to the Louisana Offshore Oil Port (LOOP) spill response planning area. 28 references, 9 tables.

0210 Legislation And Regulation

47442 **Case for petroleum pipeline deregulation.** Coburn, L.L. (Dept. of Energy, Washington, DC). *Energy Law Journal;* 3: No. 2, 255-272(1982).

The case for pipeline deregulation is strong, and should be tested now while pipeline regulatory choices are under consideration. The author looks at the petroleum pipeline industry in general, describing its characteristics and the evolution of the present regulatory structure. He discusses the choices now available to the Federal Energy Regulatory Commission (FERC) and to the Congress. He then examines the deregulation option, and concludes with the reasons for pursuing rate deregulation at this time. The proposal is for a first step, not full deregulation and not without allowing special cases. 172 references, 2 tables.

0220 Transport, Pipelines, And Handling

REFER ALSO TO CITATION(S) 02200047975

0230 Properties

47443 **(AD-A—141701/3) Pilot field testing of Arctic engine oil in army combat/tactical vehicles at Fort Carson, Colorado and Fort Lewis, West Virginia. Interim report January 1977-June 1981.** Tosh, J.D.; Alvarez, R.A.; Butler, W.E.; Owens, E.C.; Bowen, T.C. Jul 1982. 43p. (AFLRL—157; SWRI—05-6800-210/1). NTIS, PC A03/MF A01.

Military lube orders for combat and tactical equipment specify use of a single-viscosity grade lubricant with the grade depending on seasonal or climatic conditions. The use of this oil results in seasonal oil changes, regardless of the condition of the oil. Also, standard issue oils do not offer sufficient lubricant and engine protection over a wide range of ambient temperatures. Pilot field testing was conducted at Fort Carson, CO and Fort Lewis, WA. The objective of the testing was to evaluate the capability of MIL-L-46167 (5) arctic oil (OEA) to provide an interim solution to the lubrication problems being encountered. In addition, the data derived from the test were to be used as a basis for developing multigrade engine oils for Army tactical and combat equipment and to gain supplemental information covering the use of OEA lubricant over expanded temperature ranges.

47444 **(AD-A—142194/0) Basic study of fuel storage stability. Final report 15 July 1980-30 March 1984.** Mayo, F.R. (SRI International, Menlo Park, CA (USA)). May 1984. 13p. NTIS, PC A02/MF A01.

The goal of this program was to determine the chemistry of deposit formation on hot parts of diesel and jet turbine engines and thus to predict and prevent deposit formation. These deposits are assumed to come mostly from soluble gum formed on storage. The fuels used for the study were distilled at low pressure and stored under nitrogen and refrigeration. We measured rates of oxygen absorption from air, R sub 0 and total gum formation, r sub g at 130

C without initiator and at 100 with added t-Bu202. The gum measured was mostly or wholly soluble in the fuel; insoluble gum, if any, was a minor product.

47445 (PB—84-186063) Compendium of reported physical and chemical characterization data for petroleum and synthetic fuel products. Volume 1. Petroleum and shale oil products. Quilivan, S.; Panahloo, A.; Ghassemi, M.; Haro, M. (TRW Energy Systems Group, Redondo Beach, CA (USA)). Oct 1982. 277p. NTIS, PC A13/MF A01.

See also Volume 2, PB84-186071.

This compendium consolidates a large quantity of diverse data which have been generated and reported by numerous investigators over the past several decades. The products for which data have been compiled are: crude petroleum, raw and hydrotreated shale oil, raw and hydrotreated whole coal liquids and intermediates, and petroleum-, coal-, and shale-derived naphtha, jet and diesel fuels and other light fuel oils, heavy fuel oils, and residua. Coal liquids addressed are those from H-Coal, EDS, SRC-I and SRC-II direct coal liquefaction processes. Sixty-six individual properties relating to the following six characterization categories are covered: general physical and chemical properties, elemental composition data, hydrocarbon compound class properties, nitrogen-, oxygen-, and sulfur-containing compounds/compound class properties, properties of various distillation fractions, and properties of 'non-primary' products and their distillation fractions. Primarily, this effort has consisted of assembling data and has not included evaluation of data quality or the development of conclusions as to similarities and differences between a synfuel and its analogous petroleum product. Limitations of the data base are noted.

47446 (PB—84-186071) Compendium of reported physical and chemical characterization data for petroleum and synthetic fuel products. Volume 2. Direct coal liquefaction products. Quinlivan, S.; Panahloo, A.; Ghassemi, M.; Haro, M. (TRW Energy Systems Group, Redondo Beach, CA (USA)). Oct 1982. 648p. NTIS, PC A99/MF A01.

See also Volume 1, PB84-186063.

This compendium consolidates a large quantity of diverse data which have been generated and reported by numerous investigators over the past several decades. The products for which data have been compiled are: crude petroleum, raw and hydrotreated shale oil, raw and hydrotreated whole coal liquids and intermediates, and petroleum-, coal-, and shale-derived naphtha, jet and diesel fuels and other light fuel oils, heavy fuel oils, and residua. Coal liquids addressed are those from H-Coal, EDS, SRC-I and SRC-II direct coal liquefaction processes. Sixty-six individual properties relating to the following six characterization categories are covered: general physical and chemical properties, elemental composition data, hydrocarbon compound class properties, nitrogen-, oxygen-, and sulfur-containing compounds/compound class properties, properties of various distillation fractions, and properties of 'non-primary' products and their distillation fractions. Primarily, this effort has consisted of assembling data and has not included evaluation of data quality or the development of conclusions as to similarities and differences between a synfuel and its analogous petroleum product. Limitations of the data base are noted.

47447 (PB—84-190990) Comparative analysis of contaminated heating oils. Final report May 1982-December 1983. Hall, R.R.; Ellersick, R.J.; Hoyt, M.; Kozik, M.F.; McGrath, D.F. (GCA Corp., Bedford, MA (USA). GCA Technology Div.). Apr 1984. 220p. (GCA-TR—83-41-G). NTIS, PC A10/MF A01.

The report gives results of an exploratory investigation of the possible contamination of virgin heating oils by hazardous waste in the New Jersey/New York area. Twenty oil samples, including some that were suspected to be contaminated, were analyzed for 39 volatile organic compounds. In addition, total chlorine and water extractable chlorides were measured in 13 samples. A statistically valid sampling program was developed to determine the extent of heating oil contamination in New York City.

47448 (PB—84-206028) Method for evaluation of petroleum products corrosivity using piezoelectric crystals. Part 1. Roffey, R.; Nilsson, H.; Olofsson, G. (Foersvarets Forskningsanstalt, Umea (Sweden)). Apr 1984. 38p. (In Swedish). (FOA-C—40189-B4). NTIS, PC E04/MF E01.

English Abstract.

A method has been developed for testing corrosivity of stored jet-fuel. The method is based on the use of piezoelectric crystals covered with silver. If piezoelectric crystals are exposed to corrosive compounds like sulphur which react with silver the change in oscillations will be proportional to the mass difference. In this report the method is described and characterized. The method can be seen as a complementary and more sensitive method to the standard method for silver corrosivity (IP 227/73). This work has been carried out as part of a project concerning microbial problems during long term storage of jet fuel in rock caverns sponsored by the National Board of Economic Defence in Sweden (OEF).

0240 Storage

REFER ALSO TO CITATION(S) 02400047444, 47975

03 NATURAL GAS

0301 Reserves

REFER ALSO TO CITATION(S) 03010047419, 47420, 47422

47449 National petroleum council study on unconventional gas. D'Andrea, L. (United States Department of Energy). pp 621-628 of Proceedings of the 1981 International Gas Research Conference. Rockville, MD, USA; Government Institutes, Inc. (1982). (CONF-810909—).

From International gas research conference; Los Angeles, CA, USA (28 Sep 1981).

The National Petroleum Council Study on Unconventional Gas Sources represents a major contribution to the state of knowledge and understanding in the recovery and production of unconventional gas sources. The sources studies by the Council were coal seams, Devonian shale, geopressured brines, and tight gas reservoirs. The study examined the resource base, the state-of-the-art of recovery technology, potential reserves and production, constraints and uncertainties associated with each source. The overall conclusion of the study is that natural gas from coal seams, Devonian shale, and tight gas could make a significant contribution to future U.S. natural gas supply. There is considerable uncertainty in the estimates of reserve additions and production rates, and that economic conditions will influence considerably the rate of development of these sources.

0302 Geology And Exploration

REFER ALSO TO CITATION(S) 03020047423, 47425, 47428

0303 Drilling, Production, And Processing

REFER ALSO TO CITATION(S) 03030047419, 47449

0305 Health And Safety

REFER ALSO TO CITATION(S) 03050047433

0306 Marketing And Economics

REFER ALSO TO CITATION(S) 03060047428, 47435

47450 (CONF-8405234—1) Remarks re: Alaska resources conference. Hickel, W.J. May 1984. 6p. Greater Seattle Chamber of Commerce, 1200 One Union Square, 6th and Univ., Seattle, WA 98101. File Number TI84901837.

From 3. Alaska Resources conference; Seattle, WA, USA (6 May 1984).

Alaska has an immense amount of natural gas buried beneath its North Slope. It is important to the nation's energy needs and to Alaska's need for a more diversified economy that this gas be marketed. Currently there is plenty of gas to meet America's energy needs. The lack of this one market does not foreclose the existence of other markets. A potential market lies in the Pacific Basin, in Asia. By passing legislation banning export of Alaska's North Slope oil, America has decided not to compete in Asia. These laws were passed not for the purpose of energy conservation, but to protect the status quo. The speaker stresses the need for America to decide to be competitive. That is how forces are brought together to build a gas pipeline across Alaska. Since the nine billion dollar oil pipeline was completed in 1977, more than that amount has been spent in construction, processing and drilling on the North Slope. That work has come in on time and under budget. A project is being planned that would make the 14.5 million tons of LNG available from Prudhoe Bay for export to Japan, Korea and Taiwan. The goal is to decide to do the project before starting the work.

47451 **Government management of natural gas import issues. Part 2. Hearing before the Subcommittee on Energy, Nuclear Proliferation, and Government Processes of the Committee on Governmental Affairs, US Senate, Ninety-Eighth Congress, First Session, July 29, 1983.** Washington, DC, USA; Government Printing Office (1983). 11p.

This report deals with the subcommittee hearing on natural gas import issues with Sen. Charles H. Percy, chairman. Last fall, consumers throughout Illinois began paying for imported Canadian gas. In March, consumers in the central and southern part of the state began paying for imported liquefied natural gas at prices almost three times that of domestically available gas. Canada has begun to realize that its border price is too high, and has implemented a 31% cut in price. The role of Canada in gas trade with the US is discussed. A chart is included with data showing the average pipeline acquisition prices of domestic vs imported gas prices.

47452 **Indefinite escalators; 1985: does FERC have a "stairway" down?.** Hughes, J.D. (Federal Energy Regulatory Commission, Washington, DC). *Energy Law Journal;* 4: No. 2, 189-199(1983).

The impact of "indefinite escalator" and "most favored nation" clauses on interstate natural gas scheduled for decontrol in 1985 in today's economic environment of excess gas deliverability could involve 87% of the gas subject to contracts containing deregulation clauses, of which 85% contain "most favored nation" clauses that would be triggered by oil parity contracts. The author reviews the history and analyzes the legal efficacy and power of the Federal Energy Regulatory Commission (FERC) to curtail or modify the operation of such clauses in contracts between producers and pipelines in the absence of legislation to amend the Natural Gas policy Act before 1985. Incentive options offer some promise, but it may be necessary to examine FERC's ability to involuntarily terminate the clauses in the event of market disorder and a different economy in 1985. 64 references.

0309 Artificial Stimulation

REFER ALSO TO CITATION(S) 03090047403

47453 **(PB—84-211457) Co-production of gas and water. Annual technical report March 1982-January 1984.** Langford, D.A.; Peterson, K.; Parisi, B. Feb 1984. 126p. NTIS, PC A07/MF A01.

The objectives of this research effort were to locate, evaluate, acquire and test one or more co-productive prospects. A prospect identification program was developed to locate prospective coproduction reservoirs on the Texas Gulf Coast. The reservoirs identified were ranked according to their potential for enhanced gas recovery and are monitored and updated from industry activity on or near the prospects. Two of the highest ranking prospects have been recommended for GRI participation after comprehensive geologic and engineering study, and a small limited project is currently in progress on one of these, Northeast Hitchcock field. The other prospect, Port Arthur, is still active but will require additional industry support in order to proceed with a field test. GRI participation in a field wide prospect at Northeast Hitchcock was recommended and this prospect continues to be a viable alternative to Port Arthur. A limited field test in the Mt. Selman field in East Texas was recommended and approved by GRI. This field test was an opportunity for GRI to participate in a field project of a watered-out hydropressured reservoir. Eaton has worked to encourage industry support of co-production research.

0310 Legislation And Regulation

47454 **National energy policy - the Department of Energy's perspective.** Johnson, R.T. (Dept. of Energy, Washington, DC). *Energy Law Journal;* 3: No. 2, 331-336(1982).

The author explores the national energy policy pursued by the Reagan administration and the DOE, and how the future of natural gas fits into that policy. In contrast to previous adminstrations, the author finds current policy supportive of a healthy, unencumbered private sector economy to produce and distribute adequate supplies of energy. The administration wants to work with industry, including the gas industry to streamline the federal apparatus, making it supportive rather than managerial and cooperative rather than adversarial.

0320 Transport, Pipelines, And Handling

47455 **Statistical methods for monitoring cathodic protection.** Mack, G.; Peice, B. (Battelle's Columbus Lab). pp 1782-1792 of Proceedings of the 1981 International Gas Research Conference. Rockville, MD, USA; Government Institutes, Inc. (1982). (CONF-810909—).

From International gas research conference; Los Angeles, CA, USA (28 Sep 1981).

One element of the cathodic protection system to mitigate corrosion in onshore gas transmission pipeline is to maintain a negative potential of .85 volts along the full length of the line. Periodic monitoring is conducted to insure adequate cathodic protection. A plan based on the concepts of statistical sampling has the potential to provide a low cost, informative solution to the monitoring problem. The plan consists of two complementary components: a field sampling design that designates where, and how often to sample and a computer-based information management system that is used to store, retrieve and summarize data on pipeline characteristics. The field data that are collected, are stored in the system and used to update the field monitoring plans to be used in the next period.

0330 Properties

REFER ALSO TO CITATION(S) 03300047578

47456 **(PB—84-189109) Thermophysical properties of fluids for the gas industry. Annual report January-December 1983.** (National Bureau of Standards, Boulder, CO (USA)). 15 Apr 1984. 39p. NTIS, PC A03/MF A01.

See also PB83-195081.

Work carried out in the Fluid Properties Group, National Bureau of Standards, Boulder, supported by the Gas Research Institute is discussed. Results obtained in the calendar year 1983 are outlined. The most important are: viscosity data for the mixture C_1/C_2 and C_1/N_2 and for the pures n- and i-butane; a correlation of the thermodynamic properties of H_2S; and density and dielectric constant data for the components of LNG. Preliminary results for H_2/C_1 mixtures are also reported. The overall philosophy and technical resources of the group are discussed. Plans for the future are noted.

47457 **(PB—84-202647) Liquefied natural gas densities: summary of research program at the National Bureau of Standards. Final report.** Haynes, W.M.; McCarty, R.D.; Hiza, M.J. (National Engineering Lab. (NBS), Washington, DC (USA)). Oct 1983. 249p. (NBS-MONO—172). NTIS, PC A11/MF A01.

Also available from Supt. of Docs as SN003-003-02587-9. Library of Congress catalog card No. 83-600608.

This report summarizes the results of a project concerning the densities of liquefied natural gas (LNG) and its components. This project, initiated in the Properties of Fluids Section of the Cryogenics Division of the National Bureau of Standards in July 1972, was carried out under the sponsorship of a consortium of eighteen energy companies. The density data have been used to optimize, test, and compare several mathematical models as to their suitability for the calculation of LNG densities for custody transfer. Models selected for optimization and testing included an extended corresponding states method, a hard sphere model, a cell model, and an empirical model due to Klosek and McKinley. The ultimate goal of this project was to produce one or more mathematical models that could be used to predict the density of any LNG mixture to within an uncertainty of 0.1 percent from an input of pressure, temperature, and composition. After revisions based on the new experimental data from this project, each of the models investigated here satisfy this goal for typical LNG compositions. The limitations and ranges of validity of the various models are discussed. Also presented are techniques for predicting LNG densities from dielectric constant measurements and from excess volume calculations. The last section of this report consists of publications that provide a complete and detailed account of the results of this project.

47458 **(PB—84-214394) Phase and volumetric studies for methane/synthesis gas separations: the hydrogen-carbon monoxide-methane system. Final report January 1979-December 1983.** Kobayashi, R.; Hong, J.; Magee, J.W.; Jett, M.D. (Rice Univ., Houston, TX (USA)). 15 Mar 1984. 138p. NTIS, PC A07/MF A01.

See also PB83-256677.

The report obtains (1) vapor-liquid-equilibrium (V-L-E) data for the hydrogen-methane-carbon monoxide system at cryogenic temperatures and elevated pressures and (2) PVT data for the same system from -190 to 400C at pressures up to 10,000 psi. Reliable methods of predicting the physical properties of natural gas mixtures are necessary for metering and in designing transport, separation and purification equipment associated with gaseous fuels. This need is particularly pronounced in view of the wide range of conditions which are met in practical applications, and it is growing increasingly important as the prospect of recovering and processing less conventional gas supplies grows more urgent. The separation of synthesis gas consisting of various concentrations of hydrogen and carbon monoxide from methane and other light hydrocarbons is a major step in the manufacture of SNG from coal. Since the separation(s) must be conducted at cryogenic temperatures, it is energy intensive. If accurate data are not available at the design stage, gas recovery and processing facilities may be overdesigned, with large cost increases for the gas industry and ultimately the gas consumer. This grant is collecting data which are useful for design purposes, but which also provide critical tests of predictive equations for fluid mixtures.

47459 **(PB—84-215094) Heat-of-mixing experiments for liquefied gases. Annual report November 1982-October 1983.** Zollweg, J.A.; Streett, W.B. Feb 1984. 19p. NTIS, PC A02/MF A01.

Calorimetric measurements of the excess enthalpy in the systems krypton/xenon at 163 K and nitrogen/oxygen at 80 K have been performed in our batch mixing calorimeter. The observed equimolar excess enthalpy for Kr/Xe, (109 +or- 10) J/mol, is significantly larger than had been expected, but the value for N_2/O_2, (63.2 +or- 1.2) J/mol is in good agreement with other recent measurements. Comparison between earlier excess enthalpy measurements on the system carbon dioxide / ethane and molecular thermodynamics perturbation theory predictions was performed. It showed that the use of Kohler mixing rules for the unlike-pair interaction parameters in the perturbation theory gives better agreement with experiment than the traditional Lorentz-Berthelot mixing rules.

0340 Combustion

47460 **(PB—84-203165) Application of non-Gaussian light scattering to measurements in a propane flame.** Jakeman, E.; Klewe, R.C.; Richards, P.H.; Walker, J.G. 1984. 29p. (TF—158). NTIS, PC E04/MF E04.

The photon statistics of light scattered from an expanded laser beam which has passed through a laboratory propane flame are shown to be similar to those for light scattered from other deep random phase screens. The intensity fluctuations arise from the discrete eddy structure of the flame which Schlieren photographs confirm as having a broad size distribution. Intensity cross-correlation measurements using two point detectors positioned in the fluctuating scattered beam and at various distances from the flame give well defined velocities which in the near field are closely related to the convection velocity. It is also shown that when there are clearly defined regions of the flame with different mean convection velocities the cross-correlation measurements give separate results for each region. (Copyright (c) Central Electricity Generating Board.)

47461 **(PB—84-214352) Experimental and analytical investigation of a pulse combustion water heater. Final report October 1979-January 1984.** Soedel, W.; Schoenhals, R.J.; Lee, J.H.; Huang, H.C.G. Feb 1984. 36p. (R—11; HL—84-3). NTIS, PC A03/MF A01.

See also PB81-202020.

Gas-fired pulse combustion devices possess certain advantages over conventional burners, including increased capacity, reduced size, enhanced efficiency, automatic rejection of exhaust gases and consistency of operation over long time periods. This project was conducted in order to acquire an understanding of the phenomena occurring in pulse combustion devices. This information is needed to assist in the design and development of quiet, high performance pulse combustion units. An experimental pulse combustion water heater was operated in the laboratory. In addition, a computer simulation was developed based on a Helmholtz Resonator-type model. Comparisons of computer predictions and observations obtained from the experimental unit reveal that the simulation is successful in predicting the nature of the transient start-up behavior as well as the frequency and amplitude of the combustion chamber pressure oscillations. Recent refinements incorporated into the computer simulation program are described. Also, the measurements obtained from the experimental system while operating in the steady-burning mode are used to evaluate the enhancement in heat transfer which occurs as a result of flow pulsations when the unit operates in the pulse combustion mode.

04 OIL SHALES AND TAR SANDS

0403 Drilling, Fracturing, And Mining

REFER ALSO TO CITATION(S) 04030047464

0404 Oil Production, Recovery, And Refining

REFER ALSO TO CITATION(S) 04040047466

47462 **(DOE/LC/10787—130) Investigation of the Geokinetics horizontal in situ oil shale retorting process. Seventh annual report, 1983.** Henderson, K.B. (ed.). Aug 1984. Contract FC20-78LC10787. 153p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE85001930.

In the Geokinetics process, a pattern of blast holes is drilled from the surface, through the overburden, and into the oil shale bed. The holes are loaded with explosives and fired using a carefully planned blast system. The blast produces a fragmented mass of oil shale with high permeability. The fragmented zone constitutes an in situ retort. The project site is in the Mahogany Zone oil shale in Utah. During 1983 significant milestones were achieved. The burn of Retort No. 26 was completed on February 22, 1983, having produced 22,889 barrels of oil. By the end of July, 1983, all preparations were complete for the ignition of Retort No. 27. However, ignition was delayed until August 11, 1983, pending completion of the retort off gas processing facility. By early October, final preparations for the ignition of Retort No. 28 were completed and the retort was ignited on October 18, 1983. A facility to remove ammonia and hydrogen sulfide contaminants from Retorts No. 27 and No. 28 off gas was constructed at the site. Numerous environmental tests and experiments were conducted, primarily to gather data for permitting purposes. A pond to hold water produced by Retorts No. 27 and No. 28 was completed during August, 1983. The pond was put into service at the same time as the ignition of Retort No. 27.

47463 **(SAND—84-1561) Oil Shale Program quarterly report, October 1983-March 1984.** Hommert, P.J (ed.). (Sandia National Labs., Albuquerque, NM (USA)). Sep 1984. Contract AC04-76DP00789. 86p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85002135.

Recent field experiments have demonstrated that the yield from an in situ retort is largely controlled by the characteristics of the rubble bed produced during the bed preparation step. This realization has focused the need to develop a predictive capability for the fragmentation step in the process of constructing an in situ retort. In addition, it is important that criteria for the blast results be developed that are based on a thorough understanding of retort yield as a function of bed characteristics. The influence of permeability structure on retort yield must be clearly defined. At the present time the Sandia program addresses the two interrelated areas of: bed preparation and characterization and the retorting process. The formation assessment work on the SB-1 and SB-2 shots was completed with the exception of the crater coring effort. Reduction of the electronic gage data from SB-1 and SB-2 was completed. The hydrodynamic code, DYNA2D, with a constitutive oil shale damage model, was used to make comparisons with SB-1 and SB-2 electronic data. The long term motion data from SB-1 and SB-2 is being used to calibrate the motion code, BLOCKS. An assessment of the initial series of permeability contrast runs has been completed. The laboratory data indicate conclusively that permeability contrasts in and of themselves introduce yield loss. The two dimensional retort model, WAFEOS, has been implemented on the Sandia computer system. An outline for the oil shale research program at Sandia was prepared.

0405 Properties And Composition

REFER ALSO TO CITATION(S) 04050047329

0406 Direct Uses And By-products

REFER ALSO TO CITATION(S) 04060047445, 47446

0408 Marketing And Economics

47464 **(DOE/RA/32012—T9) Preliminary analysis of surface mining options for Naval Oil Shale Reserve 1.** 20 Jul 1981. Contract AC01-78RA32012. 164p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE84006951.

The study was undertaken to determine the economic viability of surface mining to exploit the reserves. It is based on resource information already developed for NOSR 1 and conceptual designs of mining systems compatible with this resource. Environmental considerations as they relate to surface mining have been addressed qualitatively. The conclusions on economic viability were based primarily on mining costs projected from other industries using surface mining. An analysis of surface mining for the NOSR 1 resource was performed based on its particular overburden thickness, oil shale thickness, oil shale grade, and topography. This evaluation considered reclamation of the surface as part of its design and cost estimate. The capital costs for mining 25 GPT and 30 GPT shale and the operating costs for mining 25 GPT, 30 GPT, and 35 GPT shale are presented. The relationship between operating cost and stripping ratio, and the break-even stripping ratio (BESR) for surface mining to be competitive with room-and-pillar mining, are shown. Identification of potential environmental impacts shows that environmental control procedures for surface mining are more difficult to implement than those for underground mining. The following three areas are of prime concern: maintenance of air quality standards by disruption, movement, and placement of large quantities of overburden; disruption or cutting of aquifers during the mining process which affect area water supplies; and potential mineral leaching from spent shales into the aquifers. Although it is an operational benefit to place spent shale in the open pit, leaching of the spent shales and contamination of the water is detrimental. It is therefore concluded that surface mining on NOSR 1 currently is neither economically desirable nor environmentally safe. Stringent mitigation measures would have to be implemented to overcome some of the potential environmental hazards.

0409 Waste Research And Management

47465 **(PB—84-211226) Method of chemical analysis for oil shale wastes.** Wallace, J.R.; Alden, L.; Bonomo, F.S.; Nichols, J.; Sexton, E. (Denver Research Inst., CO (USA)). Jun 1984. 250p. NTIS, PC A11/MF A01.

Several methods of chemical analysis are described for oil shale wastewaters and retort gases. These methods are designed to support the field testing of various pollution control systems. As such, emphasis has been placed on methods which are rapid and sufficiently rugged to perform well under field conditions. Ion chromatograph has been developed as a technique for the minor non-carbonate inorganic anions in retort water, including SO4, NO3, S2O3, SCN(-1), and total S. The method recommended for sulfide is a potiometric titration with Pb(II). The freezing point depression was used to determine the total solute content in retort waters, a test which can be considered analogous to the standard residue test. Three methods are described for the determination of total ammoniacal nitrogen in retort wastewaters: (1) a modified ion selective electrode technique, (2) an optical absorption technique, and (3) an ion chromatographic technique. Total sulfur in retort gas is determined by combusting the gas in a continuously flowing system, whereupon the resulting sulfur dioxide is determined by SO2 monitor. Individual sulfur species in retort gas including H2S, COS, SO2, and CH3CH2SH are determined by gas chromatography with flame photometric detection. Quality control, pH, conductivity, total inorganic carbon, and total organic carbon measurements are discussed briefly.

0410 Enviromental Aspects

REFER ALSO TO CITATION(S) 04100047464, 48577

47466 **(PB—84-173806) Infiltration and permeability testing at geokinetics oil shale site.** Hoylman, E.W.; Quinn, G.W. Mar 1984. 37p. NTIS, PC A03/MF A01.

Infiltration (double-rint) and pressure permeability (packer) tests were conducted in or near true in-situ oil shale retorts and at adjacent undisturbed locations to obtain comparative data to evaluate the potential for groundwater pollution due to increased fluid migration resulting from this retorting methodology. Tests were performed at the Geokinetics oil shale site located in Section 2, Township 14 South, Range 22 East, Uintah County, Utah. Test results suggest a slight increase in surface infiltration rates and hydraulic conductivity in or near the retort areas. It is expected that this type of true in-situ retorting will pose very little, if any, threat to groundwater resources in the area.

47467 **(PB—84-198936) Macroinvertebrate inventories of the White River, Colorado, and Utah: significance of annual, seasonal, and spatial variation in the design of biomonitoring networks for pollution detection.** Hornig, C.E. Jun 1984. 159p. NTIS, PC A08/MF A01.

An aquatic macroinvertebrate monitoring program is suggested for 'early warning' detection of toxic discharges to streams in oil shale development areas. Changes in stream biota are used to signal need for increasing levels of chemical analyses to identify and quantify toxic pollutants. This study compiles invertebrate data taken during three seasons (spring, summer and fall) and over five years (1976 to 1980) from riffles along the White River in Colorado and Utah. Spatial and temporal variations in the biota are described along with their implications for the development of a monitoring system that incorporates such comparative surveys. In addition, the data provide benthic biological information that is generally comparable to previous studies on the White River and which can be used to expand the biological monitoring data base prior to commercial scale oil shale development.

05 NUCLEAR FUELS

REFER ALSO TO CITATION(S) 05000047856

0501 Reserves

REFER ALSO TO CITATION(S) 05010047366, 47368, 47420, 47954

47468 (DOE/IA/06316—T2, pp C1-C8) **Sources of uranium for nuclear power in the Republic of Korea.** Swanson, V.E. Sep 1981. NTIS, PC A12/MF A01. File Number TI84011647.

In Republic of Korea/United States cooperative energy assessment. Volume III. Reference reports. Part 1 of 3 parts.

A forward-looking and competently staffed uranium exploration program has been underway in Korea for the past 4 years. Though the country lacks the sizable sandstone or Precambrian conglomerate uranium deposits of several other nations, and the prospects of the discovery of such deposits are very low, South Korea does have a major uranium-bearing black slate resource. By generally accepted international standards, the black slate would be classed as subeconomic, its average U_3O_8 content is 0.038%, which is less than the 0.08% cutoff grade of currently mined deposits in other parts of the world. As of January 1, 1980, slightly more than 31 million metric tons (t) of proved reserves of minable black-slate ore zones of average grade of 0.038% U_3O_8 (range 0.022 to 0.041% U_3O_8) had been blocked out by core drilling. Drilling for additional reserves in an 80-km-long belt (450 km^2) continues. The black-slate ore also contains potentially valuable byproduct metals: vanadium, copper, nickel, and zinc, which are extractable with the uranium during an acid-leaching process. Further, the conversion of the 10 to 35% of carbon in the ore for process-heat requirements, and the conversion of the 3 to 8% of pyrite-sulfur for the sulfuric acid leaching indicate a process-flow design that would be nearly economical under current metal-market conditions. If pressed by prohibitive rises in imported fuel prices and/or unreliable international market sources, the Republic of Korea advisedly should develop the capability to immediately exploit and utilize its own only known major energy-fuel resource - urnanium.

47469 (DOE/IA/06316—T2, pp D1-D15) **Assessment of thorium resources in the Republic of Korea.** Hall, R.B. Sep 1981. NTIS, PC A12/MF A01. File Number TI84011647.

In Republic of Korea/United States cooperative energy assessment. Volume III. Reference reports. Part 1 of 3 parts.

There are substantial resources of thorium in the Republic of Korea in monazite, a phosphate of rare-earth elements, especially of cerium and lanthanum, which also contains varying amounts of thoria (ThO_2). We lack sufficient analytical data to determine precisely the average thoria content in Korea monazite, but an average of 4.5% ThO_2 is thought to be conservative and is the figure used here for deposits or districts from which analyses are lacking. The monazite occurs as tiny grains in the sand and gravel of most stream and river valleys of Korea as a constituent in the s-called black-sand or heavy-mineral (specific gravity greater than 3.5) fraction of the alluvium, which also contains ilmenite, magnetite, garnet, zircon, and sparse amounts of other more rare minerals. Many of the heavy-mineral or black-sand placers were prospected during and since World War II, either by reconnaissance methods or by drilling with Empire-type placer drills. Modest tonnages of low-grade impure monazite concentrate have been produced by primitive hand-panning or sluicing and mechanical concentrating methods. The concentrate was sold, mostly to Japan, and probably was valued more for its rare earths than for thorium. A total potential resource of 1 million metric tons (t) of monazite in placers is estimated for the Republic of Korea. Assuming an average ThO_2 content of 4.5% in Korean monazite, a potential thoria resource of 45,000 t is indicated. The first 5000 t of ThO_2 would be recoverable at appreciably lower cost than the remaining 40,000 t because, logically, the richer and most economically worked deposits would be the first to be exploited and exhausted. However, once monazite sand has been produced by dredging, and concentrated by gravity, electromagnetic, and electrostatic methods, further chemical processing to extract thoria and the coproduct rare-earth compounds would cost the same, irrespective of the cost of mining and concentrating.

47470 (GJBX—7-84) **Uranium in granites from the southwestern United States: actinide parent-daughter systems, sites and mobilization. Second year report. National Uranium Resource Evaluation.** Silver, L.T.; Woodhead, J.A.; Williams, I.S.; Chappell, B.W. (California Inst. of Tech., Pasadena (USA). Div. of Geological and Planetary Sciences). Sep 1984. Contract AC07-76GJ01664. 348p. NTIS, PC A15/MF A01; 1; GPO Dep. File Number DE85001342.

Results of detailed field and laboratory studies are reported on the primary distribution of uranium (and thorium and lead) in the radioactive minerals of five radioactive granite bodies in Arizona and California. This distribution was examined in a granite pluton. Granites with uranium concentrations ranging from 4 to 47 ppM, thorium concentrations from 11 to 181 ppM, and Th/U ratios of 0.6 to 16.0 were compared. Evidence for secondary mobilization, migration, fixation and/or loss of uranium, thorium and radiogenic leads was explored. Uranium distribution in radioactive granites is hosted in a far greater diversity of sites than has previously been known. Uranium and thorium distribution in primary minerals of granites is almost entirely a disequilibrium product involving local fractionation processes during magmatic crystallization. Every radioactive granite studied contains minerals that contain uranium and/or thorium as major stoichiometric components. When the granites are subject to secondary geochemical events and processes, the behavior of uranium is determined by the stability fields of the different radioactive minerals in the rocks. The two most powerful tools for evaluating uranium migration in a granite are (a) isotope dilution mass spectrometry and (b) the electron microprobe. Uranium mobilization and loss is a common feature in radioactive granites of the southwestern United States. A model for the evaluation of uranium loss from granites has been developed. The mineral zircon can be used as an independent indicator of uranium and thorium endowment. The weathering products show surprising differences in the response of different granites in arid region settings. Significant losses of primary uranium (up to 70%) has been a common occurrence. Uranium, thorium and radiogenic lead exist in labile (movable) form on surfaces of cleavages, fractures and grain boundaries in granites.

0503 Mining

REFER ALSO TO CITATION(S) 05030047510

0504 Feed Processing

REFER ALSO TO CITATION(S) 05040047564, 47810

47471 (INIS-mf—9040, pp 174-176) **Uranium processing. What wastes?.** Ashbrook, A.W.; Moffett, D. (Eldorado Nuclear Ltd., Ottawa, Ontario (Canada)); Jarrell, J.P. (Eldorado Nuclear Ltd., Port Hope, Ontario (Canada)). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

0505 Enrichment

REFER ALSO TO CITATION(S) 05050047485

47472 (K/PS—819) **Uranium deposition study on aluminum: results of early tests.** Hughes, M.R.; Nolan, T.A. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 19 Jun 1984. Contract AC05-84OT21400. 18p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84017575.

Laboratory experiments to quantify uranium compound deposition on Aluminum 3003 test coupons have been initiated. These experiments consist of exposing the coupons to normal assay UF_6 (0.7% ^{235}U) in nickel reaction vessels under various conditions of UF_6 pressure, temperature, and time. To-date, runs from 5 minutes to 2000 hr have been completed at a UF_6 pressure of 100 torr and at a temperature of 60°C. Longer exposure times are in progress. Initial results indicated that a surface film of uranium, primarily as uranyl fluoride (UO_2F_2), is deposited very soon after exposure to UF_6. In a five minute UF_6 exposure at a temperature of 60°C, an average of 2.9 μg U/cm^2 was deposited; after 24 hr the deposit typically increased to 5.0 μg/cm^2 and then increased to 10.4 μg/cm^2 after 2000 hr. This amount of deposit (at 2000 hr exposure) would contribute roughly 10 to 20% to the total 186 keV gamma signal obtained from a GCEP product header pipe being operated at UF_6 pressures of 2 to 5 torr. The amount of isotopic exchange which would occur in the deposit in the event that HEU and LEU productions were alternated is considered. It is felt that isotopic exchange would not occur to any significant amount within the fixed deposit during relatively short HEU production periods since the HEU would be present primarily as adsorbed UF_6 molecules on the surface of the deposit. The adsorbed HEU molecules would be removed by evacuation and diluted by LEU production. Major increases in the deposit count would be observed if a leak occurred or moisture was introduced into the system while HEU was being produced.

0506 By-products

REFER ALSO TO CITATION(S) 05060047788, 48278

0507 Fuels Production And Properties

REFER ALSO TO CITATION(S) 05070047567, 48254

0508 Spent Fuels Reprocessing

REFER ALSO TO CITATION(S) 05080047484, 47566, 47810

47473 **(CONF-840793—1) Advanced remotely maintainable force-reflecting servomanipulator concept.** Kuban, D.P.; Martin, H.L. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85001902.

From USDOE/ORNL/PNC national topical meeting on robotics and remote handling in hostile environments; Tokyo, Japan (24 Jul 1984).

A remotely maintainable force-reflecting servomanipulator concept is being developed at the Oak Ridge National Laboratory as part of the Consolidated Fuel Reprocessing Program. This new manipulator addresses requirements of advanced nuclear fuel reprocessing with emphasis on force reflection, remote maintainability, reliability, radiation tolerance, and corrosion resistance. The advanced servomanipulator is uniquely subdivided into remotely replaceable modules which will permit in situ manipulator repair by spare module replacement. Manipulator modularization and increased reliability are accomplished through a force transmission system that uses gears and torque tubes. Digital control algorithms and mechanical precision are used to offset the increased backlash, friction, and inertia resulting from the gear drives. This results in the first remotely maintainable force-reflecting servomanipulator in the world. 10 references, 4 figures, 1 table.

47474 **(CONF-840793—3) Control and electronic subsystems for the advanced servomanipulator.** Martin, H.L.; Hamel, W.R.; Killough, S.M.; Spille, R.F. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85001900.

From USDOE/ORNL/PNC national topical meeting on robotics and remote handling in hostile environments; Tokyo, Japan (24 Jul 1984).

The advanced servomanipulator (ASM) represents a new generation of electrically driven force-reflecting manipulator systems designed to be remotely maintainable. This ASM is being developed to perform remote maintenance in a nuclear fuel reprocessing plant where human access is not allowed. The primary function of the manipulator control system is to maintain stable, accurate master/slave operation while providing sensitive force reflection to the operator. The control system is based upon tightly coupled distributed digital microprocessing methods. The architectural structure of the control system is outlined and is compared to the previously developed Model M-2 control system, and justification for the advances incorporated into the ASM structure are given. The various modes of operation and diagnostics are described, and throughput requirements associated with joint servo-control and counter-balancing are discussed. The fundamental elements of the control system are reviewed, including the processor selection (Motorola MC68000) and the language (FORTH). The purpose of this document is to review the design decisions and the resulting design selections to serve as a base for future improvements. Four main areas will be covered: (1) system overview, (2) hardware implementation, (3) software partitioning, and (4) remote electronics considerations. Each area will address the specifics of the selected equipment or the functional requirements of the control method. 9 references, 4 figures.

47475 **(CONF-840793—4) Elements of an advanced integrated operator control station.** Clarke, M.M.; Kreifeldt, J.G. (Tufts Univ., Medford, MA (USA)). 1984. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85001899.

From USDOE/ORNL/PNC national topical meeting on robotics and remote handling in hostile environments; Tokyo, Japan (24 Jul 1984).

One of the critical determinants of performance for any remotely operated maintenance system is the compatibility achieved between elements of the man/machine interface (e.g., master manipulator controller, controls, displays) and the human operator. In the remote control engineering task of the Consolidated Fuel Reprocessing Program, considerable attention has been devoted to optimizing the man/machine interface of the operator control station. This system must be considered an integral element of the overall maintenance work system which includes transporters, manipulators, remote viewing, and other parts. The control station must reflect the integration of the operator team, control/display panels, manipulator master controllers, and remote viewing monitors. Human factors principles and experimentation have been used in the development of an advanced integrated operator control station designed for the advance servomanipulator. Key features of this next-generation design are summarized in this presentation. 7 references, 4 figures.

47476 **(CONF-840793—6) Lighting for remote viewing systems.** Draper, J.V. 1984. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85001898.

From USDOE/ORNL/PNC national topical meeting on robotics and remote handling in hostile environments; Tokyo, Japan (24 Jul 1984).

Scenes viewed by television do not provide the same channels of information for judgment of distances as scenes viewed directly, since television eliminates or degrades several depth perception cues. However, it may be possible to improve depth perception of televised scenes by enhancing the information available through depth cues that are available from lighting. A literature survey and expert opinions were integrated to design a remote lighting arrangement which could enhance depth perception of operators performing remote handling operations. This paper describes the lighting arrangement and discusses some of its advantages and disadvantages. 10 references, 2 figures.

47477 **(CONF-840916—4) Advancement of remote technology: past perspectives and future plans.** Feldman, M.J.; Hamel, W.R. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85000934.

From Robotics and remote handling in the nuclear industry conference; Toronto, Ontario, Canada (23 Sep 1984).

In the Consolidated Fuel Reprocessing Program at the Oak Ridge National Laboratory, a comprehensive remote systems development program has existed for the past five years. The new remote technology under development is expected to significantly improve remote operations by extending the range of admissible remote tasks and increasing remote work efficiency. The motivation and justification for the program are discussed by surveying the 40 years of remote operating experience which exists and considering the essential features of various old and new philosophies which have been, or are being, used in remote engineering. A future direction based upon the Remotex concept is explained, and recent progress in the development of an advanced servomanipulator-based maintenance concept is summarized to show that a new generation of remote systems capability is feasible through advanced technology. 20 references, 9 figures, 1 table.

47478 (DOE/TIC—3396-Suppl.1) **Radioactive waste management: a series of bibliographies. Nuclear fuel cycle: reprocessing. Supplement 1.** McLaren, L.H. (ed.). (USDOE Technical Information Center, Oak Ridge, TN). Sep 1984. 138p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE84013561.

This bibliography contains information on spent fuel reprocessing included in the Department of Energy's Energy Data Base from December 1982 through December 1983. The 555 citations in this bibliography are to research reports, journal articles, books, patents, theses, and conference papers from worldwide sources. Five indexes are provided: Corporate Author, Personal Author, Subject, Contract Number, and Report Number.

47479 (GAO/RCED—84-21) **Status and commercial potential of the Barnwell Nuclear Fuel Plant.** Bowsher, C.A. (General Accounting Office, Washington, DC (USA). Office of the Comptroller General). 28 Mar 1984. 44p. US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760. File Number TI84901488.

In October 1981, President Reagan lifted the indefinite deferral on commercial reprocessing of nuclear spent fuel in the United States that the previous administration had established in 1977. This raised speculation that the Barnwell Nuclear Fuel Plant - a privately owned, partially constructed reprocessing plant - could become operational. This report examines the status and the commercial potential of the plant. Three overall observations can be drawn from the information presented in the report. The potential for commercial reprocessing to develop in the United States is driven by economics in the private marketplace which is closely tied to the future role that nuclear power will have as a domestic energy source. Before private industry seriously considers starting another commercial reprocessing venture, nuclear industry representatives believe three issues associated with commercial reprocessing - the use of plutonium as a fuel source, an acceptable solidified high-level radioactive waste form, and guarantees against changes in federal policies - must be addressed. Technical assessments of the plant and GAO discussions with knowledgeable persons within and outside the government disclose no apparent fundamental problems that currently would prohibit the plant from operating when completed. A number of technical concerns and licensing issues need to be resolved, however, before the plant could operate as a commercial venture. In addition, the economic prospect for the plant as a commercial venture is not promising.

47480 (INIS-mf—9040, pp 203-206) **Release of ^{134}Cs, ^{137}Cs and ^{129}I from the fuel-sheath gap of CANDU irradiated fuel.** Burns, K.I.; Moore, C.J. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

47481 (INIS-mf—9040, pp 211-215) **Characterization of the off-gas released from CANDU fuel to the dissolver off-gas system to the EUREX pilot plant.** Alonzo, G.G. (Comitato Nazionale per l'Energia Nucleare, Saluggia (Italy). Programma Eurex); Castellani, F.F.; Curzio, G.G.; Gentili, A.F.; Pieve, L.F. (Pisa Univ. (Italy). Ist. di Impianti Nucleari). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

47482 (ORNL/TM—9187) **Consolidated fuel reprocessing program. Progress report, January 1-March 31, 1984.** (Oak Ridge National Lab., TN (USA)). Aug 1984. Contract AC05-84OR21400. 44p. NTIS, PC A03/MF A01; GPO Dep. File Number DE84017638.

All research and development on fuel reprocessing in the United States in managed under the Consolidated Fuel Reprocessing centered at the Oak Ridge National Laboratory. Technical progress is reported on the following: BRET project; process and engineering R & D; engineering systems; integrated equipment test facility operations; HTGR fuel reprocessing; and strategic planning and analysis.

0509 Transport And Storage

REFER ALSO TO CITATION(S) 05090047499

47483 (DOE/NE/44158—T2) **International spent fuel program. Technical progress report, October 1, 1981-December 31, 1981.** (Boeing Engineering and Construction Co., Seattle, WA (USA)). [1984]. Contract AC01-81NE44158. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85001602.

The status is given of the Pacific Basin joint feasibility study and the international spent fuel management study for IAEA.

47484 (EPRI-NP—3682) **Impacts of extended advanced spent-fuel storage on reprocessing. Final report.** Anderson, R.T. (Allied-General Nuclear Services, Barnwell, SC (USA)). Aug 1984. 95p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920042.

This report evaluated the effect of various spent fuel storage methods on the operations of a nuclear fuel reprocessing plant. A survey was made of the various techniques being considered to expand at-reactor storage capacity and their effect on fuel integrity. Variations of these techniques employ dry storage, fuel assembly canistering, and rod consolidation. The fuel receipt operations and chemical plant procedures developed for the Barnwell Nuclear Fuel Plant were used as a basis for comparison. The study examined areas of possible incompatibility between reprocessing operations and the proposed storage methods. The results show that storage of fuel for nominally 10 years or more prior to reprocessing is generally advantageous from the standpoint of plant maintenance, waste disposal, and reprocessing plant operation. Extended storage is not expected to increase the incidence of failed fuel. However, reprocessing plants do have equipment limits which must be considered by the designers of fuel storage processes. In particular, the implementation of certain fuel canistering concepts could effectively preclude fuel receipt at the reprocessing plant. Technical guidelines are included, which serve as guidance to engineers who are involved in evaluating new spent fuel storage concepts.

0510 Marketing And Economics

47485 (GAO/RCED—84-156) **Information on DOE's costing and pricing of uranium enrichment services.** (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). 25 Apr 1984. 24p. US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760. File Number TI84901487.

Report to The Chairman, Subcommittee on Energy Conservation and Power, House Committee on Energy and Commerce.

The Department of Energy (DOE) provides domestic and foreign customers with enriched uranium for use as commercial nuclear power reactor fuel. Competition from foreign enrichment suppliers and from a secondary market of surplus enriched uranium has led to a significant decline in DOE's enrichment sales. During a March 1, 1984, hearing before the subcommittee, GAO commented on a number of DOE initiatives and proposals designed to improve the uranium enrichment program's viability. This report addresses topics raised during that hearing and presents information on (1) DOE's historic pricing policy and practices associated with providing uranium enrichment services, (2) the historical annual enrichment costs and prices, (3) the accumulated profit or loss reported in the enrichment program's financial statements, (4) the implications for recovering DOE's cost of providing enrichment services at the $135 ceiling price provision contained in the new enrichment services contract, and (5) details on GAO's efforts to obtain information from DOE on the ceiling price provision.

0520 Waste Management

REFER ALSO TO CITATION(S) 05200047471, 47480, 47481, 47554, 47555, 47556, 47557, 47558, 47559, 47560, 47561, 47562, 47566, 47808, 47857, 48179, 48183, 48226, 48233, 48254, 48270, 48280, 48309, 48310, 48493, 48494, 48512, 48598, 48599, 48602, 48604

47486 (AEC—180/87) Solid radioactive wastes: long-term storage in central Kansas salt mine. (USAEC Division of Reactor Development and Technology, Washington, DC). 12 Jun 1970. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84016927.

After considering AEC 180/81 dated April 23, 1970, which discussed the development of plans for site acquisition, construction, and operation of a demonstration facility for long-term storage of solidified high-level radioactive waste and alpha-contaminated waste in bedded salt formations, the Commission approved in principle the concept of long-term storage of high-level and low-level radioactive waste in an appropriately designed salt mine in the Central Kansas bedded salt formations, and authorized staff to take necessary actions to enable AEC to seek authorization and funding in FY 1972 to acquire a site and construct a salt mine storage facility. Based on existing information of the Lyons, Kansas site derived principally from Project Salt Vault it appears that this site is well suited for construction of a long-term storage facility for high-level and alpha-contaminated solid waste. Appendix A summarizes the criteria and reasons for the selection of the Lyons, Kansas site. There are other sites in the Kansas area and possibly in New York and Michigan as well as along the Gulf Coast which may, after investigation, prove to be suitable. However, necessary investigations to prove out the acceptability of these sites would result in considerable delay estimated to be on the order of two years, and existing knowledge of these areas gives us no reason to believe they would be more acceptable.

47487 (BMI/OCRD—12) Typical repository conditions for generic commercial and defense high-level nuclear waste and spent fuel repositories in crystalline rock. (Battelle Memorial Inst., Columbus, OH (USA). Office of Crystalline Repository Development). Aug 1984. Contract AC06-76RL01830;AC02-83CH10139. 36p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85001949.

This report summarizes activities to determine conditions for temperature, pressure, fluid, chemical, and radiation environments typical of those that may be expected to exist in commercial and defense high-level nuclear waste and spent fuel repositories in crystalline rock. In the DOE Crystalline Repository Project, the term crystalline rocks are defined as intrusive igneous and high-rank metamorphic rocks rich in silicate minerals with a grain size sufficiently coarse that individual materials can be distinguished with the unaided eye. These conditions were generated by the Reference Repository Conditions Interface Working Group (RRC-IWG), an ad hoc IWG established by the National Terminal Storage (NWTS) Program's Isolation Interface Control Board. The repository conditions are based on the standard room-and-pillar mined repository concept with waste emplaced in vertical holes drilled in the room floor. Some important results obtained are given below for the selected local areal thermal loadings of 20, 25, and 13.5 W/m^2 for spent fuel (SF), commercial high-level waste (CHLW), and defense high-level waste (DHLW), respectively. In all cases, the results below are given in order for SF, CHLW, and DHLW. Some thermal results are: maximum waste temperature - 190, 225, and 120°C; maximum rock temperature - 150, 165, and 105°C. The length of time for significant thermal exposure is greater for SF than the other wastes. Vapor phase pressures are not expected to rise significantly above atmospheric until the repository is sealed. After sealing, the water pressure inside the sealed excavations will gradually increase to the local hydrostatic head. A generic crystalline rock ground-water composition and expected gamma radiation dose rates are also provided in the report. 11 references, 10 figures, 6 tables.

47488 (BMI/ONWI—19(FY-84)) Salt Repository Project. FY-84 technical project plan. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Aug 1984. Contract AC02-83CH10140. 81p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85001801.

The FY 84 technical plans for the Salt Repository Project (SRP) are briefly presented. The objectives of the project in relation to the Civilian Radioactive Waste Management (CRWM) program are discused and the technical activities directed toward accomplishing these objectives are detailed. A budget is presented for each of the Level 2 Work Breakdown Structure Tasks (Systems, Waste Package, Site, Repository, Regulatory and Institutional, Test Facilities, Exploratory Shaft, Land Acquisition, and Program Management) in an appendix. An overall description, current status, and planned activities are presented for each of the subtasks which make up the above-mentioned Level 2 tasks. Milestones and their definitions for the plan year, as well as milestones for the outyears are also presented at this same subtask level for each subtask.

47489 (BNL-NUREG—27773) NRC nuclear waste management technical support in the development of nuclear waste form criteria. Task 4. Test development review. Czyscinski, K.S.; Swyler, K.J.; Klamut, C.J. (Brookhaven National Lab., Upton, NY (USA)). May 1980. Contract AC02-76CH00016. 96p. NTIS, PC A05/MF A01 - GPO. File Number TI84017347.

This interim report concerns the development of testing procedures to assess the performance of waste packages to be used for high-level waste disposal in geologic repositories. Single component testing of the waste package is determined to be a workable strategy for testing and evaluation in terms of NRC release rate criteria. An initial literature review has identified key tests and those variables which must be included in testing procedures to simulate repository conditions. The range of these conditions remains to be determined precisely. Methods for leach, corrosion, and sorption testing are reviewed and initial recommendations made for preferred procedures. A combination of static and dynamic tests is needed to evaluate waste package component performance. Additional research is necessary in certain areas both to establish reliable testing methods and to define the range of testing variables. Research recommendations are included in the report. Ancillary measurements will be required to ensure that key tests rigorously assess the durability of waste package components under anticipated repository conditions. In particular, radiation effects in the repository environment must be considered and, where necessary, simulated during critical testing. Research is recommended to aid in determining when and how this should be done.

47490 (BNL-NUREG—34896) Source term development for tritium at the Sheffield disposal site. MacKenzie, D.R.; Barletta, R.E.; Smalley, J.F.; Kempf, C.R.; Davis, R.E. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 5p. (CONF-841157—1). NTIS, PC A02/MF A01 - GPO; GPO Dep. File Number TI84014387.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1984).

The Sheffield low-level radioactive waste disposal site, which ceased operation in 1978, has been the focus of modeling efforts by the NRC for the purpose of predicting long-term site behavior. To provide the NRC with the information required for its modeling effort, a study to define the source term for tritium in eight trenches at the Sheffield site has been undertaken. Tritium is of special interest since significant concentrations of the isotope have been found in groundwater samples taken at the site and at locations outside the site boundary. Previous estimates of tritium site inventory at Sheffield are in wide disagreement. In this study, the tritium inventory in the eight trenches was estimated by reviewing the radioactive shipping records (RSRs) for waste buried in these trenches. It has been found that the tritium shipped for burial at the site was probably higher than previously estimated. In the eight trenches surveyed, which amount to roughly one half the total volume and activity buried at Sheffield, approximately 2350 Ci of tritium from non-fuel cycle sources were identified. The review of RSRs also formed the basis for obtaining waste package descriptions and for contacting large waste generators to obtain more detailed information regarding these waste packages. As a result of this review and the selected generator contacts, the non-fuel cycle tritium waste was categorized. The tritium releases from each of these waste categories were modeled. The results of this modeling effort are presented for each of the eight trenches selected. 3 references, 2 figures.

47491 **(BNL-NUREG—34897) Leachability of decontamination reagents from cement waste forms.** Piciulo, P.L.; Davis, M.S.; Adams, J.W. (Brookhaven National Lab., Upton, NY (USA)). 26 Nov 1984. Contract AC02-76CH00016. 4p. (CONF-841157—2). NTIS, PC A02/MF A01 - GPO; GPO Dep. File Number TI84014348.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1984).

Brookhaven National Laboratory, in order to provide technical information needed by the US Nuclear Regulatory Commission to evaluate the adequacy of near-surface disposal of decontamination wstes, has begun to study the leachability of organic reagents from solidified simulated decontamination wastes. Laboratory-scale cement waste forms containing EDTA, picolinic acid or simulated LOMI decontamination reagent were leach tested. Samples containing an organic reagent on either mixed bed ion-exchange resins or anion exchange resins were tested. A fixed interval leach procedure was used, as well as the standard procedure ANS 16.1. The leachability indices measured for the release of the acid from resin/cement composites are: 10.1 for EDTA on mixed bed resins; 9.1 for picolinic acid on mixed bed resins; 9.2 for picolinic acid on anion exchange resins; 8.8 for picolinic acid in forms containing simulated low oxidation metallic ion (LOMI) reagent on mixed bed resins and 8.7 for picolinic acid in forms containing simulated LOMI reagent on anion exchange resins. The leachability indices measured varied with leach time and the data indicate that the release mechanism may not be simply diffusion controlled. 5 references, 2 tables.

47492 **(CONF-8409115—2) Anaerobic digestion of cellulosic wastes.** Donaldson, T.L.; Lee, D.D. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84017330.

From 6. annual Low-Level Waste Management Program participants information meeting; Denver, CO, USA (11 Sep 1984).

Anaerobic digestion is a potentially attractive technology for volume reduction of cellulosic wastes. A substantial fraction of the waste is converted to off-gas and a relatively small volume of biologically stabilized sludge is produced. Process development work is underway using a 75-L digester to verify rates and conversions obtained at the bench scale, to develop start-up and operating procedures, and to generate effluent for characterization and disposal studies. Three runs using batch and batch-fed conditions have been made lasting 36, 90, and over 200 days. Solids solubilization and gas production rates and total solids destruction have met or exceeded the target values of 0.6 g cellulose per L of reactor per day, 0.5 L off-gas per L of reactor per day, and 80% destruction of solids, respectively. Successful start-up procedures have been developed, and preliminary effluent characterization and disposal studies have been done. A simple dynamic process model has been constructed to aid in further process development and for use in process monitoring and control of a large-scale digester. 7 references, 5 figures, 1 table.

47493 **(CONF-8409115—3) Planning for greater-confinement disposal.** Gilbert, T.L.; Luner, C.; Meshkov, N.K.; Trevorrow, L.E.; Yu, C. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85002143.

From 6. annual Low-Level Waste Management Program participants information meeting; Denver, CO, USA (11 Sep 1984).

This contribution is a progress report for preparation of a document that will summarize procedures and technical information needed to plan for and implement greater-confinement disposal (GCD) of low-level radioactive waste. Selection of a site and a facility design (Phase I), and construction, operation, and extended care (Phase II) will be covered in the document. This progress report is limited to Phase I. Phase I includes determination of the need for GCD, design alternatives, and selection of a site and facility design. Alternative designs considered are augered shafts, deep trenches, engineered structures, high-integrity containers, hydrofracture, and improved waste form. Design considerations and specifications, performance elements, cost elements, and comparative advantages and disadvantages of the different designs are covered. Procedures are discussed for establishing overall performance objectives and waste-acceptance criteria, and for comparative assessment of the performance and cost of the different alternatives. 16 references.

47494 **(DOE/DP/48015—1) Review of the scientific and technical criteria for the Waste Isolation Pilot Plant (WIPP).** 1984. Contract AC01-83DP48015. 138p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE84016620.

The panel has evaluated the scientific and technical adequacy of work being done on the Waste Isolation Pilot Plant (WIPP) project to satisfy the charge to the panel set out in Chapter 1. The panel concluded that the scientific work has been carried out with a high degree of professional competence. The panel notes that the geology revealed by shaft sinking and excavation of drifts and the preliminary measurements generally confirm the geologic expectations derived from surface explorations and boreholes. The purity and volume of the salt, the absence of brine pockets at the repository horizon in the areas excavated, the absence of breccia pipes and of toxic gases, and the nearly horizontal bedding of the salt indicate that a repository can be constructed that will meet the geologic criteria for site selection. Thus, the important issues about the geology at the site have been resolved, but there remain some issues about the hydrology and design of the facility that should be resolved before large-scale transuranic (TRU) waste emplacement begins. The panel's conclusions and recommendations regarding the following studies are presented: site selection and characterization; in-situ tests and experiments; waste acceptance criteria; design and construction of underground facilities; and performance assessment. 65 references, 17 figures, 3 tables.

47495 **(DOE/ID—10055(83)) Radioactive waste management information for 1983.** Cassidy, G.B. (EG and G Idaho, Inc., Idaho Falls (USA)). Jul 1984. Contract AC07-76ID01570. 284p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE84017409.

The following reports have been developed from the Waste Management Information System and are included: INEL year-to-date summary report, disposed or stored; radionuclide decay reports, 1 to 10 years; radionuclides disposed and stored at INEL, monthly and year-to-date; waste volume reduction facility data; and facility waste reports, monthly and year-to-date.

47496 **(DOE/ID/12434—2) Discussion paper: siting a low-level radioactive waste disposal facility in the Central Interstate Low-Level Radioactive Waste Compact region. A model for other regions.** Peery, R.J. Jul 1984. Contract FG07-83ID12434. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84017231.

While this paper is intended to be broad enough in scope to cover the concerns and implementation guidelines of any compact commission, the focus will be on the procedures and guidelines that must be followed under the terms of the Central Interstate Low-Level Radioactive Waste Compact. This is not necessarily an endorsement of the Central States Compact approach to siting but is rather an attempt to discuss the siting process by using an existing compact as an example. As stated earlier, each compact commission will have to follow the specific guidelines of its compact. Many of the procedures to be followed and technical standards to be considered, however, apply to all the compacts.

47497 **(DOE/LLW—28T) Experience and related research and development in applying corrective measures at major low-level radioactive waste disposal sites.** (Evaluation Research Corp., Oak Ridge, TN (USA)). Aug 1984. Contract AC07-76ID01570. 75p. NTIS, PC A04/MF A01; GPO Dep. File Number DE84017344.

This report describes corrective measures for the following seven generic problem conditions at low-level waste disposal facilities: unstable trench cover; permeable trench cover; subsidence; groundwater entering trenches; intrusion of deep-rooted plants; intrusion of burrowing animals; and chemical and physical conditions in trenches. Conclusions drawn in this report are based on the results of experience and research and development projects at six major Department of Energy sites and at the six commercial disposal sites. Three of these commercial sites are no longer operating. Effectiveness of the corrective measures varied, due to differences in climatologic, geologic, hydrologic, and biological conditions at these disposal sites. Thus, the report emphasizes the desirability of determining causes of problems to which corrective actions would then be directed. 50 references, 20 figures, 8 tables.

47498 **(DOE/LLW—35T) Commission waste management.** (Southern States Energy Board, Atlanta, GA (USA); EG and G Idaho, Inc., Idaho Falls (USA)). Sep 1984. Contract FG07-83ID12434;AC07-76ID01570. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84017391.

States that have committed to fulfilling their obligations for managing their low-level radioactive waste have created interstate compacts. These compacts in turn created commissions which ensure that waste management policies generated by the compacts are implemented. Waste management concerns faced by commissions are identified in this report, and a framework provided within which these issues can be addressed.

47499 **(DOE/NV/10250—15) Commercial Nuclear Waste Research and Development Program. Quarterly report, April-June 1984.** Hakl, A.R. (Westinghouse Electric Corp., Mercury, NV (USA). Waste Technology Services Div.). Jul 1984. Contract AC08-82NV10250. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85001356.

All nuclear materials handling and packaging and other related activities are performed at the E-MAD (Engine Maintenance, Assembly and Disassembly) facility in Area 25 of the Nevada Test Site. Activities performed during the third quarter of Fiscal Year (FY) 1984 to meet task objectives of the Nevada Nuclear Waste Storage Investigations FY 1984 Project Plan are reported. A Statement of Work was prepared and transmitted to DOE which provided detailed cost and schedule estimates for dry storage cask demonstrations. The canister in which fuel assembly D34 was stored, and which was partially immersed in water during Climax storage tests due to a leaking liner, was cut into sections which will be inspected by Lawrence Livermore National Laboratory (LLNL). Thermal monitoring of canisterized fuel assembly B03 was discontinued and the fuel assembly was removed from Drywell No. 3. Fuel Temperature Test (FTT) operations, simulating storage of a fuel assembly in a metal storage cask, were completed for months 13 and 14 temperature profiles. A new methodology was introduced to evacuate the total atmosphere of the FTT system and replace it with fresh air with each monthly gas sampling operation. Remote fuel handling operations were performed to monitor integrity of fuel assemblies in welded storage canisters and in unwelded canisters. Material Interaction Test assemblies were retrieved, disassembled, decontaminated, and shipped to Hanford Engineering Developmental Laboratory for examination to determine the effects of storage tests.

47500 **(EGG—2304) Decontamination and decommissioning of CPP-601 process cells A, B, C, D, and L. Final report.** Smith, D.L.; Scott, J.G. (EG and G Idaho, Inc., Idaho Falls (USA)). Sep 1984. Contract AC07-76ID01570. 89p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85001317.

This report describes the decontamination and decommissioning (D and D) of the Idaho Chemical Processing Plant (ICPP) process cells A, B, C, D, and L. The ICPP is located at the Idaho National Engineering Laboratory (INEL). These five process cells became radioactively contaminated during nuclear fuel processing in the 1950s and 60s. The report describes the work performed to accomplish the D and D objectives of reducing radiation and contamination problems, and making the cells available for possible future installation of new systems. The contaminated equipment inside each cell was removed as well as the out-of-cell equipment associated with each cell. The interior of each cell was then decontaminated. 3 references, 93 figures, 7 tables.

47501 **(EGG-M—26083) Processing and certification of defense transuranic waste at the INEL.** Clements, T.L. Jr.; Cargo, C.H.; McKinley, K.B.; Smith, T.H.; Anderson, B.C. (EG and G Idaho, Inc., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 12p. (CONF-840802—18). NTIS, PC A02/MF A01; GPO Dep. File Number DE84017308.

From International topical meeting on fuel reprocessing and waste management; Jackson Hole, WY, USA (26 Aug 1984).

Since 1970, defense-generated transuranic waste has been placed into 20-year retrievable storage at the Radioactive Waste Management Complex at the Idaho National Engineering Laboratory (INEL). A major objective of the US Department of Energy (DOE) Nuclear Waste Management Program is to remove all retrievably stored transuranic waste form the INEL. To support this objective, the Stored Waste Examination Pilot Plant (SWEPP) and the Process Experimental Pilot Plant (PREPP) are currently being constructed. SWEPP will certify waste, using nondestructive examination techniques, for shipment to the Waste Isolation Pilot Plant (WIPP). PREPP will process uncertifiable waste into a certifiable waste form. 3 references.

47502 **(GJ/TMC—16) Test and evaluation of selected instruments for surface gamma-ray measurements.** Key, B.N. (Bendix Field Engineering Corp., Grand Junction, CO (USA)). Aug 1984. Contract AC07-76GJ01664. 163p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE85000354.

The US Department of Energy (DOE) Division of Remedial Action Projects has responsibility for the cleanup of radioactive contamination resulting from defunct federal projects as well as from commercial facilities operated by or for the Department of Energy and its predecessor agencies. These cleanup activities are conducted under the auspices of four programs: the Uranium Mill Tailings Remedial Action Project, the Formerly Utilized Sites (Manhattan Engineer District/Atomic Energy Commission) Remedial Action Program, the Surplus Facilities Management Program, and the Grand Junction Remedial Action Program. The Technical Measurements Center of the DOE Grand Junction Area Office provides technical support to each program. One element of that support involves preparation of a series of reports designed to compare and evaluate available instruments used in making measurements in support of DOE remedial action programs. This report, one of that series, presents results of a study conducted to test and evaluate selected instruments to determine their applicability and effectiveness for use in making surface gamma-ray measurements. Design characteristics that affect performance in remedial-action applications are examined. Also presented are the results of tests conducted to assess several aspects of instrument performance, including counting-plateau quality, sensitivity to battery-voltage variation, temperature sensitivity, dead time, linearity, sensitivity to high ambient radiation, counting sensitivity, and spectral response. In general, the instruments performed satisfactorily; exceptions are discussed and, where apparent, the probable cause of unsatisfactory performance is suggested. Recommendations are made with respect to design and performance characteristics to aid in the selection of instrumentation for use in remedial-action work.

47503 (INIS-mf—9040, pp 151-153) **Model of nuclide migration in unsaturated zone.** Tasaka, H.; Asano, T.; Akimoto, Y. (Mitsubishi Metal Corp., Tokyo (Japan)). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

47504 (INIS-mf—9040, pp 251-252) **Groundwater transport of reactive contaminants near the CRNL waste management areas. Some realities.** Killey, R.W.D. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

47505 (INIS-mf—9040, pp 313-316) **Fracture hydrology and radionuclide transport.** Bourke, P.J.; Evans, G.V. (UKAEA Atomic Energy Research Establishment, Harwell). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

47506 (INIS-mf—9040, pp 317-318) **Regional and room-scale hydrological simulations of the Atikokan site.** La Fleur, D.W.; Rama Rao, B.S.; Reeves, M. (INTERA Environmental Consultants Ltd., Ottawa, Ontario (Canada)). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

47507 (INIS-mf—9040, pp 309-310) **Nature of fracture fillings in the Eye-Dashwa lakes pluton, Atikokan, Ontario and their significance to hydrogeological and geochemical aspects of nuclear fuel waste management.** Kamineni, D.C.; Stone, D. (Geological Survey of Canada, Ottawa, Ontario); Vandergraaf, T.T. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

47508 (INIS-mf—9040, pp 311-312) **Geological, geophysical and hydrogeological investigations at the site of the planned underground research laboratory.** Brown, A. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment); Davison, C.C.; Soonawala, N.M. (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada)). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

47509 (INIS-mf—9040, pp 319-320) **Theoretical analysis of mass transport in fractured media.** Schwartz, F.W.; Crowe, A.S. (Alberta Univ., Edmonton (Canada)); Smith, L. (British Columbia Univ., Vancouver (Canada)). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

47510 (INIS-mf—9040, pp 292-297) **Analysis of atmospheric pathways of exposure at Jackpile mine.** Momeni, M.H.; Dungey, C.E.; Roberts, C.J. (Argonne National Lab., IL (USA)). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

47511 (INIS-mf—9040, pp 169-170) **Uranium tailings in Canada. Regulation and management.** Boulden, R.S.; Bragg, K. (Atomic Energy Control Board, Ottawa, Ontario (Canada)). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

47512 (INIS-mf—9040, pp 171) **Uranium tailings management practices at Elliot Lake, Ontario.** Davis, J.B. (Golder Associates, Toronto, Ontario (Canada)); Culver, K.B.; Pullen, P.F. (Rio Algom Ltd., Elliot Lake, Ontario (Canada)). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

47513 (INIS-mf—9040, pp 172-173) **Uranium mine waste management in Saskatchewan.** Larson, D.W.; Robertson, B.E. (Regina Univ., Saskatchewan (Canada)); Woods, R.J. (Saskatchewan Univ., Saskatoon (Canada)). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

47514 (INIS-mf—9040, pp 184-185) **Uranium mine/mill decommissioning in Saskatchewan.** Sentis, R.R.; Potter, C.L.; Wagner, E.P.; Barsi, R.G. (Saskatchewan Dept. of the Environment, Prince Albert (Canada)). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

47515 (INIS-mf—9040, pp 186-187) **Reclamation and close-out of the Beaverlodge operations of Eldorado Nuclear Limited.** Ashbrook, A.W.; Filion, M.P. (Eldorado Nuclear Ltd., Ottawa, Ontario (Canada)); Phillips, R.J. (Eldorado Nuclear Ltd., Saskatchewan (Canada)). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

47516 (INIS-mf—9040, pp 207-210) **Management modes for the radionuclides tritium, carbon-14 and krypton-85 arising from reprocessing.** Brucher, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Chemische Technologie der Nuklearen Entsorgung). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

47517 (INIS-mf—9040, pp 246-248) **Hydrologic and geological aspects of low level radioactive waste site management.** Cutshall, N.H. (Oak Ridge National Lab., TN (USA)). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

47518 (INIS-mf—9040, pp 249-250) **Hydrogeological program for Bruce NPD radioactive waste operations site 2.** Lee, C.F.; Carter, T.J.; Heystee, R.J. (Ontario Hydro, Toronto (Canada)). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

47519 (INIS-mf—9040, pp 256-258) **Preliminary analysis of intrusion into a low-level radioactive waste emplacement at a shallow depth.** Cabeza, L.; McKenna, C.; Buchnea, A. (MacLaren Engineers, Planners and Scientists Inc., Willowdale , Ontario (Canada)); Mernaph, J. (Ontario Hydro, Toronto (Canada)). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

47520 (INIS-mf—9040, pp 259-262) **Assessment of hypothetical disposal facilities for Canada's low level radioactive waste.** Buchnea, A.; Cabeza, L.; Chart, E.J. (MacLaren (James F.) Ltd., Willowdale, Ontario (Canada)); Chambers, D.B.; Lowe, L.M. (Senes Consultants, Willowdale, Ontario (Canada)). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

47521 (INIS-mf—9040, pp 276-277) **Radioecology and waste management.** Grauby, A. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Service d'Etudes et Recherches sur l'Environnement). 1982. (In French). NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

47522 (INIS-mf—9040, pp 305-306) **Hydrogeological research program for high-level waste management at the U.S. Nuclear Regulatory Commission.** Doyle, F.L. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

47523 (INIS-mf—9040, pp 321-325) **Comparison of theoretical and experimental models of heat transport from a nuclear waste repository.** Conlisk, A.T.; Christensen, R.N.; Roy, J. (Ohio State Univ., Columbus (USA)). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

47524 (INIS-mf—9040, pp 115-117) **Role of the media in structuring public concerns about nuclear fuel waste management.** Gilmour, G.M.; Greer-Wooten, B. (York Univ., Toronto, Ontario (Canada)). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

47525 (INIS-mf—9040, pp 118-120) **Ontario public's opinion of nuclear fuel waste management.** Greber, M.A.; Barrados, M. (Atomic Energy of Canada Ltd., Ottawa, Ontario). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

47526 (INIS-mf—9040, pp 121-122) **AECB approach to concept assessment for high-level radioactive waste disposal.** Conlon, P.J.; Wagstaff, K.P. (Atomic Energy Control Board, Ottawa, Ontario (Canada)). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

47527 (INIS-mf—9040, pp 132-134) **Present status and future plans for the regulation of radioactive wastes in Canada.** Smythe, W.D. (Atomic Energy Control Board, Ottawa, Ontario (Canada)). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

47528 (INIS-mf—9040, pp 266-267) **Approach to the exemption of materials from regulation as radioactive wastes.** Chatterjee, R.M.; Coady, J.R.; Wagstaff, K.P. (Atomic Energy Control Board, Ottawa, Ontario (Canada)). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

47529 (INIS-mf—9040, pp 307-308) **Discussion of the AECB's geological criteria and guidelines germane to the deep underground disposal of radioactive waste.** Wallach, J. (Atomic Energy Control Board, Ottawa, Ontario (Canada)). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

47530 **(INIS-mf—9040) International conference on radioactive waste management. Conference summaries.** (Canadian Nuclear Society, Toronto, Ontario). 1982. 338p. (CONF-820933—Summs.). NTIS (US Sales Only), PC A15/MF A01. File Number DE84780568.

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

Individual items were indexed separately for the Energy Data Base.

47531 **(KFK—1742) Pilot plant experience on high-level waste solidification and design of the engineering prototype VERA.** Guber, W.; Diefenbacher, W.; Hild, W.; Krause, H.; Schneider, E.; Schubert, G. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)). Nov 1972. 25p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84901928.

In the present paper the solidification process for highly active waste solutions as developed in the Karlsruhe Nuclear Research Center is presented. Its principal steps are: denitration, calcination in a spray calciner operated with superheated steam, melting of the calcine with appropriate additives to borosilicate glass in an induction-heated melting furnace. The operational experiences gained so far in the inactive 1:1 pilot plant are reported. Furthermore, a description is given of the projected multi-purpose experimental facility VERA 2 which is provided for processing the highly active waste solutions from the first German reprocessing plant WAK.

47532 **(LA—10006-PR) Research and development related to the Nevada Nuclear Waste Storage Investigations. Progress report, July 1-September 30, 1983.** Bryant, E.A.; Vaniman, D.T. (comps.). (Los Alamos National Lab., NM (USA)). Jul 1984. Contract W-7405-ENG-36. 103p. NTIS, PC A06/MF A01; GPO Dep. File Number DE84016972.

This report summarizes the contribution of the Los Alamos National Laboratory to the Nevada Nuclear Waste Storage Investigations for the fourth quarter of 1983. The status is given of the following investigations: water chemistry; sorption and precipitation; solubility measurements and calculations; plutonium chemistry in near-neutral solutions; hydrothermal geochemistry; hot spring analogues; flow and transport modeling; mineralogy-petrology of tuff; volcanism; rock physics; shaft and borehole sealing; and exploratory shaft. 50 references, 35 figures, 14 tables.

47533 **(NMERDI—4012202) Proposed Waste Isolation Pilot Project (WIPP) and impacts in the state of New Mexico: a socio-economic analysis. Summary of the final report, June 1, 1979-February 28, 1981.** Cummings, R.G.; Burness, H.S.; Norton, R. (New Mexico Univ., Albuquerque (USA). Dept. of Economics). Apr 1981. Contract AC04-79ET44401. 86p. (EMD—2-67-1139(S)). NTIS, PC A05/MF A01; GPO Dep. File Number DE84012202.

The purpose of this study is to identify, measure (when possible), and assess the range of potential socio-economic impacts in the state that may be attributable to the WIPP. It is not intended to provide a definitive calculation regarding the net balance of WIPP-related benefits and costs. Ten conclusions concerning impacts in the Eddy-Lea County area, three conclusions concerning state-wide monetary impacts, and nine conclusions concerning risk and risk management are presented.

47534 (NUREG/CR—3812) **Assessment of irradiation effects in radwaste containing organic ion-exchange media.** Swyler, K.J.; Dodge, C.J.; Dayal, R. (Brookhaven National Lab., Upton, NY (USA)). May 1984. Contract AC02-76CH00016. 83p. (BNL-NUREG—51774). NTIS, PC A05/MF A01 - GPO. File Number TI84016420.

Recently, regulatory consideration has been devoted to the effects of self-irradiation on radwaste containing organic ion exchange media. This consideration was prompted by decontamination operations at TMI-II, and by the development of technical positions in support of NRC regulation 10 CFR 60. This report addresses the effects of high radiation dose on the storage and disposal of radwaste ion-exchange media, and the validity of laboratory test procedures for predicting field performance. Our work shows that accelerated testing of ion-exchange media using high-dose-rate external gamma irradiation appears to be a valid procedure for assessing certain aspects of field behavior - i.e. radiolytic scission of the resin functional group, radiolytic gas generation of free liquids and resin agglomeration, provided both the test data and the field conditions refer to storage in a closed environment. Certain resin decomposition processes appear to depend largely on resin moisture content, and may not be particularly sensitive to resin loading. One practical consequence of radiolytic acidity is to promote the corrosion of mild steel in irradiated resin. However, the corrosion process is very complex. Case-specific, long-term (i.e. low radiation dose) evaluations might be necessary if rigorous guidelines to protect radwaste containers against corrosion are required. 24 references, 29 figures, 20 tables.

47535 (NVO—283) **Hydrology and water resources overview for the Nevada Nuclear Waste Storage Investigations, Nevada Test Site, Nye County, Nevada: annotated bibliography.** French, R.H.; Elzeftawy, A.; Elliot, B. (Nevada Univ., Las Vegas (USA). Desert Research Inst.). Jun 1984. Contract AC08-76DP01253. 89p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85001349.

The literature available regarding hydrology and utilization of water resources in the southwestern Nevada Test Site area is reviewed. In the context of this annotated bibliography, hydrology is defined to include hydrometeorology, surface water resources, and groundwater resources. Water utilization includes water supply, demand and use; future supply, demand and use; and wastewater treatment and disposal. The bibliography is arranged in alphabetical order and indexed with both technical key words and geographical key words.

47536 (NVO—284) **Hydrology and water resources overview for the Nevada Nuclear Waste Storage Investigations, Nevada Test Site, Nye County, Nevada.** French, R.H.; Elzeftawy, A.; Bird, J.; Elliot, B. (Nevada Univ., Las Vegas (USA). Desert Research Inst.). Jun 1984. Contract AC08-76DP01253. 124p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85001350.

The literature and available unpublished data regarding hydrology and water resources utilization in the Nevada Test Site area are summarized. This report was prepared in support of the environmental studies task of the Nevada Nuclear Waste Storage Investigations. In the context of this report, hydrology is defined to include hydrometeorology, surface water, and groundwater resources. Water resources utilization is defined to include the present water supply, demand and use, and future supply, demand and use; and wastewater treatment and disposal. 32 references, 5 figures, 13 tables.

47537 (PB—84-179324) **Waste-pond treatment with immobilized liquid ion-exchangers. Final report.** Babcock, W.C.; Baker, R.W.; Chidlaw, M.B.; Friesen, D.T.; Gunson, G.A. (Bend Research, Inc., OR (USA)). Aug 1981. 31p. NTIS, PC A03/MF A01.

The feasibility of using reagent-impregnated ion-exchange fibers to separate and remove heavy-metal ions from low-concentration solutions is established. Modules containing several hundred fibers were developed and proved to be fouling-resistant. Waste ponds that were identified as targets for further development of the technology are fly-ash settling ponds at coal-fired power plants, and uranium mine and uranium mill waste ponds which contain tailings from hydrometallurgical operations or mine-water drainage. These ponds contain sufficient concentrations of suspended solids to preclude the use of other conventional metal-removal processes. Based on studies with small modules, it was shown that copper, uranium, and chromium can be removed from these ponds and that the value of the recovered metals can be expected to yield pay-back periods of two years for copper and less than one month for uranium. Conclusions and recommendations for further work are included.

47538 (PB—84-202274) **Preparation and microstructural characterization of silicate and borosilicate glasses containing cerium or plutonium.** Izahara, S.; Peters, L.; Van Iseghem, P. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). Apr 1981. 53p. (BLG—546). NTIS, PC E05/MF E05.

The preparation of Pu-containing silicate and borosilicate glasses, referring to the conditioning of alpha contaminated and of high level waste, respectively, has been studied. The preparation of a typical borosilicate glass did not give rise to problems regarding to pouring and final homogeneity of the glass. The preparation of silicate glasses, however, was much more difficult, since at the melting temperatures available these glasses could not be poured, and showed pronounced heterogeneities. Different melting parameters, such as melting time and physico-chemical preparation of the melting batch were investigated in order to improve the homogeneity. None of these parameters had a marked beneficial influence upon the homogeneity. Chemical attack of the alumina crucible by the glass was found to be the main reason for the heterogeneities observed. Preliminary observations suggest that PuO2 has been dissolved in the glass matrix.

47539 (PB—84-203306) **Incorporation of Fe2O3, FeO and Al2O3 in silicate glasses and its effect on their structure and chemical stability.** Van Iseghem, P.; De Grave, E.; Peters, L.; De Batist, R. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). Sep 1983. 13p. (BLG—560). NTIS, PC E03/MF E03.

Large amounts of the glass intermediates Al2O3, Fe2O3 and FeO are present in the amorphous silicate slags developed at the S.C.K./C.E.N. for the conditioning of Pu contaminated radioactive waste. Strong ambiguity exists in literature about both the structural incorporation and the effect on the chemical stability of Fe2O3 and FeO. The chemical stability and its relationship to the glass structure therefore was investigated for a number of silicate base glasses, taking into consideration the following parameters (the amount of glass modifiers was kept constant at 16 mole %, equimolarly spread over Li2O, K2O, MgO and CaO): 1) Fe2Ox concentrations (x = 2 or 3) varying between 2.5 and 30 mole % (compensated by changes in SiO2 concentration); 2)Equimolar replacement of Fe2Ox by Al2O3 and Fe2Ox in all glasses listed in 1. The structural incorporation of Fe2Ox was investigated by 57 Fe Mossbauer Spectroscopy, the chemical stability by the Soxhlet corrosion test. The sample weight was measured after 14 days of corrosion, after drying and removal of the weakly bounded surface layer.

47540 (PNL—5168) **Methodology for physical modeling of melter electrode power plug.** Heath, W.O. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1984. Contract AC06-76RL01830. 80p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85001306.

A method is presented for building and testing a one-third scale model of an electrode power plug used to supply up to 3000 amperes to a liquid fed ceramic melter. The method describes how a one-third scale model can be used to verify the ampacity of the power plug, the effectiveness of the power plug cooling system and the effect of the high amperage current on eddy current heating of rebar in the cell wall. Scale-up of the test data, including cooling air flow rate and pressure drop, temperature profiles, melter water jacket heat duty and electrical resistance is covered. The materials required to build the scale model are specified as well as scale surface finish and dimensions. The method for designing and testing a model power plug involves developing a way to recreate the thermal conditions including heat sources, sinks and boundary temperatures on a scale basis. The major heat sources are the molten glass in contact with the electrode, joule heat generation within the power plug, and eddy current heating of the wall rebar. The melting cavity heat source is modelled using a plate heater to provide radiant heat transfer to a geometrically similar, one-third scale electrode housed in a scale model of a melting cavity having a thermally and geometrically similar wall and floor. The joule heat generation within the power plug is simulated by passing electricity through the model power plug with geometrically similar rebar positioned to simulate the eddy heating phenomenon. The proposed model also features two forced air cooling circuits similar to those on the full design. The interaction of convective, natural and radiant heat transfer in the wall cooling circuit are considered. The cell environment and a melter water jacket, along with the air cooling circuits, constitute the heat sinks and are also simulated.

47541 **(SAND—83-1877) Nevada Nuclear Waste Storage Investigations preliminary repository concepts report.** Jackson, J.L. (comp.). (Sandia National Labs., Albuquerque, NM (USA)). Sep 1984. Contract AC04-76DP00789. 215p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE85002132.

This report presents the preliminary repository concepts developed for the Nevada Nuclear Waste Storage Investigations Project. The concepts are for a high-level radioactive waste repository with a capacity of up to 70,000 metric tons (77,175 tons) of heavy metal initially loaded in commercial power reactors. The repository site being investigated is on and adjacent to the Nevada Test Site. The 8,094,000-m^2 (2000-acre) underground portion of the repository to be used for waste emplacement is above the water table and beneath Yucca Mountain within a welded tuff formation. The surface facilities of the repository will be located to the east of Yucca Mountain on a 304,000-m^2 (75-acre) site and include the waste-handling and surface support structures. Concepts for final closure of the underground portion of the repository and for decommissioning the surface facilities are also discussed. The engineering studies being performed in support of the design bases and design criteria are summarized. The preliminary concepts presented here will be used as a basis for the conceptual design of the repository. 55 references, 39 figures, 6 tables.

47542 **(SAND—83-2209C) Natural convection experiments about a finite-length cylindrical heat source in a liquid-saturated porous medium.** Reda, D.C. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 29p. (CONF-841121—2). NTIS, PC A03/MF A01; GPO Dep. File Number DE84012657.

From AIChE annual meeting; San Francisco, CA, USA (25 Nov 1984).

An experimental effort is under way to investigate convective heat transfer in liquid-saturated porous media utilizing a geometry, and hydrodynamic/thermal boundary conditions, relevant to the problem of nuclear waste isolation in geologic repositories. In the present work, measurements were made of the transient and steady-state thermal fields throughout an annular region bounded by vertical, coaxial cylinders. The inner cylinder was comprised of a finite-length heat source, supported above and below by insulating sections; the outer cylinder was maintained at a constant temperature. An overlying liquid layer was used to impose a permeable upper-surface boundary condition; this layer was maintained at a constant temperature equal to that of the outer cylinder. All properties of the porous medium, including porosity, permeability, and effective thermal conductivity were measured. Experimental results obtained in this effort showed steady-state heater surface temperatures (at constant heater power) to increase with increasing vertical distance due to the buoyantly driven upflow. The measured steady-state radial temperature drop across the annulus was found to systematically depart from the finite-length-cylinder conduction solution as heater power was increased. Comparisons between measured results and numerical predictions obtained using the finite-element code MARIAH showed very good agreement, thereby contributing to the qualification of this code for repository-design applications.

47543 **(UNI-SA—101) Recent national and international decommissioning experience.** Dabrowski, T.E. (UNC Nuclear Industries, Inc., Richland, WA (USA)). 22 Jun 1982. Contract AC06-76RL01857. 7p. (CONF-841105—29). NTIS, PC A02/MF A01; GPO Dep. File Number DE84015750.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; Washington, DC, USA (11 Nov 1984).

New decommissioning techniques demonstrated recently in the US and abroad include: use of oxy-acetelyne torch to cut thick reactor vessel walls rather than use of conventional plasma arc cutting techniques; improved decontamination methods, particularly with concrete; and wider use of explosive cutting. A recent development that deserves special discussion involves the decommissioning of the Shippingport Atomic Power Station in the US. One of the most promising of the new decommissioning techniques that is being planned for use at Shippingport is one-piece removal of the reactor pressure vessel. Compared to the segmentation approach, one-piece removal of the Shippingport vessel would shorten the 4-year decommissioning schedule by 1 year, would reduce the total cost by $7 million, would reduce occupational exposure from 240 rems to 140 rems, and would reduce packaging and transport of reactor vessel waste from 8 separate truck shipments to one barge shipment. In conclusion, recent decommissioning experience in the US and other countries has resulted in improvements in techniques for reducing occupational exposure, adverse impact on the environment, numbers of waste shipments, and overall project costs.

47544 **(USGS/WRI—84-4197) Ground-water level data and preliminary potentiometric-surface maps, Yucca Mountain and vicinity, Nye County, Nevada.** Robison, J.H. (Geological Survey, Lakewood, CO (USA). Water Resources Div.). 1984. Contract AI08-78ET44802. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85001771.

This report contains data on ground-water levels and preliminary maps of the potentiometric surface beneath Yucca Mountain and adjacent areas, Nye County, Nevada. The information was obtained in cooperation with the US Department of Energy to help evaluate the suitability of the area for storing high-level nuclear waste. The water-level surface shown on the maps generally represents water-table (unconfined) conditions. The water table in the Yucca Mountain area occurs in ash-flow and air-fall tuffs of Tertiary age. West of the crest of Yucca Mountain, water-level altitudes are about 775 meters above sea level. Along the eastern edge and southern end of Yucca Mountain, the potentiometric surface generally is nearly flat, is about 728 to 730 meters above sea level, and has a southeastward slope. 2 references, 2 figures, 2 tables.

47545 **(WINCO—1002-Suppl.1) ICPP effluent monitoring report. 2nd quarter CY-1984. Supplement 1.** (Westinghouse Idaho Nuclear Co., Inc., Idaho Falls (USA)). Aug 1984. Contract AC07-84ID12435. 65p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE84017307.

This report summarizes the data collected by effluent and environmental monitoring programs conducted at the Idaho Chemical Processing Plant. The period covered is from March 20, 1984 through June 19, 1984. During the second quarter of 1984, 1.92E+02 curies of activity were released from ICPP operations. Aiborne effluent releases to the atmosphere contributed approximately 1.42E+02 curies; liquid effluent releases to the Percolation Pond contributed 3.60E+00 curies; and solid waste shipped to the Radiocative Waste Complex (RWMC) contained 4.60E+01 curies. In all cases, the activity released to date has been below forecasts. Only the volume of liquid waste effluent has consistently exceeded the forecast, this may be due to the new FAST Facility and Coal-fired Steam Generating Facility (CFSGF) both coming on line this year. 28 figures, 15 tables.

47546 **(WINCO—1017) Airborne waste management program. Final report.** Brown, R.A.; Thomas, T.R. (Westinghouse Idaho Nuclear Co., Inc., Idaho Falls (USA)). Sep 1984. Contract AC07-84ID12435. 80p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85001917.

The Airborne Waste Management program is described and reports from various research organizations are presented on: particulates, tritium, krypton-85, iodine-129/iodine-131, carbon-14, effluent monitoring, and process off-gas. Lists of publications are included from each research project.

47547 **(WIPP-DOE—93) Waste Isolation Pilot Plant. Project progress report for month ending October 31, 1981.** (USDOE Albuquerque Operations Office, NM. Waste Isolation Pilot Plant Project Office). 1981. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84017625.

The purpose of the Waste Isolation Pilot Plant (WIPP) is to provide a research and development facility to demonstrate the safe disposal of radioactive wastes resulting from the defense activities and programs of the United States. The status of the following tasks related to the WIPP is given: design, technical support, drilling, shaft outfitting and mining, and scientific program.

47548 **(WIPP-DOE—164) WIPP: Waste Isolation Pilot Plant.** (USDOE Albuquerque Operations Office, NM. Waste Isolation Pilot Plant Project Office). 1984. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE84016367.

The following aspects of the Waste Isolation Pilot Plant are discussed briefly: history and site selection; salt as a disposal medium; transporting waste materials; early key events; impacts on New Mexico; project organization; and site certification profile.

47549 **The Waste Isolation Pilot Plant (WIPP) construction status.** Little, C.C.; McGough, J.M. (Westinghouse Electric Corp. Advanced Energy Systems Waste Isolation Pilot Plant P.O. Box 40039 Albuquerque, NM 87196). *Transactions of the American Nuclear Society;* **46**: 112-113(Jun 1984). (CONF-840614—).

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

47550 **WIPP site and preliminary design validation program: Initiation to completion.** Hohmann, G.L. (Westinghouse Electric Corp. Advanced Energy Systems Waste Isolation Pilot Plant P.O. Box 40039 Albuquerque, NM 87196). *Transactions of the American Nuclear Society;* **46**: 106-107(Jun 1984). (CONF-840614—).

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

47551 **Technology and policy directions in DOE transuranic waste management program.** Jicha, J.J. Jr. (U.S. Department of Energy, Washington, DC 20545). *Transactions of the American Nuclear Society;* **46**: 106(Jun 1984). (CONF-840614—).

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

47552 **Public opinion concerning the Waste Isolation Pilot Plant.** Jackson, D.G.; McGough, J.M. (U.S. Department of Energy, Washington, DC 20545). *Transactions of the American Nuclear Society;* **46**: 605-606(Jun 1984). (CONF-840614—).

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

47553 **Crystalline Rapository Project.** Madia, W.J. (Battelle Memorial Institute, 505 King Avenue, Columbus, OH 43201). *Transactions of the American Nuclear Society;* **46**: 605(Jun 1984). (CONF-840614—).

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

0530 Environmental Aspects

REFER ALSO TO CITATION(S) 05300047490, 47522, 47564, 48136, 48576

47554 **(EGG—2312) Environmental surveillance for the INEL Radioactive Waste Management Complex and other areas. Annual report, 1983.** Blanchfield, L.A.; Hoffman, L.G. (EG and G Idaho, Inc., Idaho Falls (USA)). Aug 1984. Contract AC07-76ID01570. 58p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85001918.

The 1983 environmental surveillance report for the Radioactive Waste Management Complex (RWMC) of the Idaho National Engineering Laboratory (INEL) describes the environmental monitoring activities at the RWMC, the Waste Experimental Reduction Facility (WERF), and two surplus facilities. The purpose of the monitoring activities is to provide for continuous evaluation and awareness of environmental conditions resulting from current operations, detect significant trends, and project possible future conditions. This report provides a public record comparing RWMC, WERF, and surplus facility environmental data with radiation protection standards or concentration guides established for operation of Department of Energy facilities. 11 references, 24 figures, 14 tables.

47555 (INIS-mf—9040, pp 273-275) **Canadian environmental research for nuclear waste management.** Iverson, S.L. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

47556 (INIS-mf—9040, pp 283-285) **Ecological vectors of radionuclide transport at a solid radioactive waste disposal facility in southeastern Idaho.** Arthur, W.J.; Markham, O.D. (Idaho National Engineering Lab., Idaho Falls (USA)). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

47557 (INIS-mf—9040, pp 286-291) **Contamination assessment study for Gentilly waste storage facilities.** Marche, C. (Ecole Polytechnique, Montreal, Quebec (Canada)); Schneeberger, C. (Geos, Inc., Montreal, Quebec (Canada)); Trussart, S.; Lavalle, M. (Hydro-Quebec, Montreal (Canada)). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

47558 (INIS-mf—9040, pp 298-299) **Subsurface migration model for use in radiological impact assessment of radioactive waste disposal.** Mernagh, J.R.; Sangster, R.N. (Ontario Hydro, Toronto (Canada)). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

47559 **(NUREG/CR—3940) Field experiment determinations of distribution coefficients of actinide elements in alkaline lake environments.** Simpson, H.J.; Trier, R.M.; Li, Y.-H.; Anderson, R.F.; Herczeg, A.L. (Columbia Univ., Palisades, NY (USA). Lamont-Doherty Geological Observatory). Aug 1984. 124p. NTIS, PC A06/MF A01 - GPO $5.00. File Number TI85900052.

Measurements of the radioisotope concentrations of a number of elements (Am, Pu, U, Pa, Th, Ac, Ra, Po, Pb, Cs, and Sr) in the water and sediments of a group of alkaline (pH = 9-10), saline lakes demonstrate greatly enhanced soluble-phase concentrations of elements with oxidation states of (III)-(VI) as the result of complexing by carbonate ion. Ratios of soluble radionuclide concentrations in Mono Lake to those in seawater ([CO_3^{2-}] in Mono Lake = 200 times that of seawater) were: Pu(≃10), ^{238}U(≃150), ^{231}Pa, ^{228}Th, ^{230}Th(≃10^3), and ^{232}Th(≃10^5). Effective distribution coefficients of these radionuclides in high CO_3^{2-} environments are several orders of magnitude lower (i.e., less particle reactive) than in most other natural waters. The importance of CO_3^{2-} ion on effective K/sub d/ values was also strongly suggested by laboratory experiments in which most of the dissolved actinide elements became adsorbed to particles after a water sample normally at a pH of 10 was acidified, stripped of all CO_2, and then returned to pH 10 by adding NH_4OH. Furthermore, the effect of complexation by organic ligands is of secondary importance in the presence of appreciable carbonate ion concentration. Neither pure phase solubility calculations nor laboratory scale K/sub d/ determinations accurately predicted the measured natural system concentrations. Therefore, measurements of the distribution of radionuclides in natural systems are essential for assessment of the likely fate of potential releases from high level waste repositories to groundwater. 50 references, 31 figures, 43 tables.

47560 (ORNL/TM—8631) **Plant species potentially suitable for cover on low-level solid nuclear waste disposal sites: a literature review.** Brenkert, A.L.; Parr, P.D.; Taylor, F.G. (Oak Ridge National Lab., TN (USA)). Sep 1984. Contract AC05-84OR21400. 126p. NTIS, PC A07/MF A01; GPO Dep. File Number DE84017635.

Environmental Sciences Division Publication No. 2275.

This report reviews available literature on soil conditions, hydrology, and climatological data and suggests plant species suitable for covering the low-level nuclear waste disposal areas in the White Oak Creek Watershed within the Oak Ridge Reservation. Literature on naturally invading species and secondary succession, on plant species used for reclamation of coal spoils and roadsides, and on horticultural species is reviewed. The potential of plant species to take up, or mine, the waste through deep rooting is assessed. The effects of vegetation cover on the water balance in a watershed are reviewed. Several conclusions are presented concerning the management of vegetation cover on low-level solid waste disposal areas. 163 references, 2 figures, 9 tables.

47561 (USGS/WRIR—83-4217) **Regional hydrology of the Dolores River Basin, eastern Paradox Basin, Colorado and Utah.** Weir, J.E. Jr.; Maxfield, E.B.; Zimmerman, E.A. (Geological Survey, Denver, CO (USA). Water Resources Div.). 1983. Contract AI97-79ET44611. 87p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE84017235.

The Dolores River Basin, is in the eastern part of the Paradox Basin and includes the eastern slope of the La Sal Mountains, the western slopes of the Rico and La Plata Mountains, and the southwest flank of the Uncompahgre Plateau. The climate of this area is more humid than most of the surrounding Colorado Plateau region. Precipitation ranges from slightly 200 mm/yr to 1000 mm/yr; the estimated volume of water falling on the area is 4000 x 10^6 cm^3/yr. Of this total, about 600 x 10^6 cm^3/yr is runoff; 190 x 10^6 cm^3/yr recharges the upper ground-water system; and an estimated 55 x 10^6 cm^3 returns to the atmosphere via evapotranspiration from stream valleys. The remainder evaporates. Principal hydrogeologic units are permeable sandstone and limestone and nearly impermeable salt (halitic) deposits. Structurally, the area is dominated by northwest-trending salt anticlines and contiguous faults paralleled by synclinal structures. The Uncompahgre Plateau lies along the north and northeast sides of the area. The instrusive masses that form the La Sal Mountains are laccoliths with bysmaliths and other complex intrusive forms comprising, in gross form, moderately faulted omal structures. Intrusive rocks underlie the La Plata and Rico Mountains along the southeastern edge of the area. These geologic structures significantly modify ground-water flow patterns in the upper ground-water system, but have no conspicuous effect on the flow regime in the lower ground-water system. The water in the upper ground-water system generally is fresh except where it is affected by evaporite dissolution from salt anticlines. The water of the lower ground-water system is slightly saline to briny. Water quality of the Dolores River is slightly saline to fresh, based on dissolved chemical constituents; some of the smaller tributaries of the river have saline water.

0540 Health And Safety

REFER ALSO TO CITATION(S) 05400047502, 47519, 47533, 48572

47562 (INIS-mf—9040, pp 278-282) **Model to calculate doses from iodine-129 on a local, regional and global scale from the proposed Canadian high level waste vault.** Johnson, J.R.; Van Heteren, J.G. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.); Wuschke, D.M. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

47563 (INIS-mf—9040, pp 135-137) **Bioethical issues in radioactive waste management.** Maxey, M.N. (Texas Univ., Austin (USA)). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

47564 (INIS-mf—9044) **Legislatory background of uranium recovery on Greenland with special regard for safety and environmental conditions.** Soerensen, A. (Risoe National Lab., Roskilde (Denmark)). Aug 1983. 5p. (In Danish). NTIS (US Sales Only), PC A02/MF A01. File Number DE84780615.

The actual laws on mineral resources in Greenland, on radioactive substance handling and protection and their consequences for uranium recovery at Kvanefjeld are considered. The uranium processing pilot plant at Risoe was on Danish territory and therefore subject to the Danish legislation for nuclear installations. (EG).

47565 (INIS-mf—9053, pp 27-33) **Laboratory safety in relation to ionizing radiation.** Jagt, P.J. van der (Vrije Univ., Amsterdam (Netherlands). Dienst voor Veiligheid en Milieu). 1982. (In Dutch). NTIS (US Sales Only), PC A05/MF A01. File Number TI85780001. (CONF-820199—).

From Occupational health aspects of ionising radiation meeting; Amsterdam, Netherlands (6 Jan 1982).

A survey is presented of the regulations in the Netherlands concerning radionuclide laboratories, both in hospitals and others, relating to radiation protection, buildings and interiors, toxicity of radionuclides, types of laboratory, and radiation doses permissible for radiological workers.

47566 (PNL—5209) **Krypton-85 health risk assessment for a nuclear fuel reprocessing plant.** Mellinger, P.J.; Brackenbush, L.W.; Tanner, J.E.; Gilbert, E.S. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1984. Contract AC06-76RL01830. 91p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE84017437.

The risks involved in the routine release of ^{85}Kr from nuclear fuel reprocessing operations to the environment were compared to those resulting from the capture and storage of ^{85}Kr. Instead of releasing the ^{85}Kr to the environment when fuel is reprocessed, it can be captured, immobilized and stored. Two alternative methods of capturing ^{85}Kr (cryogenic distillation and fluorocarbon absorption) and one method of immobilizing the captured gas (ion implantation/sputtering) were theoretically incorporated into a representative fuel reprocessing plant, the Barnwell Nuclear Fuel Plant, even though there are no known plans to start up this facility. Given the uncertainties in the models used to generate lifetime risk numbers (0.02 to 0.027 radiation induced fatal cancers expected in the occupational workforce and 0.017 fatal cancers in the general population), the differences in total risks for the three situations, (i.e., no-capture and two-capture alternatives) cannot be considered meaningful. It is possible that no risks would occur from any of the three situations. There is certainly no reason to conclude that risks from ^{85}Kr routinely released to the environment are greater than those that would result from the other two situations considered. Present regulations mandate recovery and disposal of ^{85}Kr from the off gases of a facility reprocessing spent fuel from commercial sources. Because of the lack of a clear-cut indication that recovery woud be beneficial, it does not seem prudent to burden the facilities with a requirement for ^{85}Kr recovery, at least until operating experience demonstrates the incentive. The probable high aging of the early fuel to be processed and the higher dose resulting from the release of the unregulated ^{3}H and ^{14}C also encourage delaying implementation of the ^{85}Kr recovery in the early plants.

0550 Regulations

REFER ALSO TO CITATION(S) 05500047472

47567 **(NUREG—0430-Vol.4-No.2) Licensed fuel facility status report. Inventory difference data, July 1983-December 1983. Volume 4, No. 2.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Inspection and Enforcement). Aug 1984. 15p. NTIS, PC A02/MF A01 - GPO*. File Number TI84901878.

NRC is committed to the periodic publication of licensed fuel facilities inventory difference data, following agency review of the information and completion of any related investigations. Information in this report includes inventory difference data for active fuel fabrication facilities possessing more than one effective kilogram of high enriched uranium, low enriched uranium, plutonium, or uranium-233.

47568 **(NUREG/CR—2499) Review of emergency radiological instrumentation and analytical methods at NMSS-licensee sites.** Herrington, W.N.; Kathren, R.L.; Kenoyer, J.L.; Jamison, J.D. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1984. Contract AC06-76RL01830. 57p. (PNL—4163). NTIS, PC A04/MF A01 - GPO $4.50. File Number TI84017319.

This report provides a brief review of emergency radiological monitoring instrumentation capabilities based on visits to Nuclear Materials Safety and Safeguards (NMSS) licensees and on a review of the open literature. Recommendations based on findings are made with regard to instrument design and operation, training, calibration, testing, analytical methods, sampling procedures, and quality assurance. An assessment of currently available instrumentation is made with respect to types of instruments, instrument specifications, future needs of NRC/NMSS licensees as seen by instrument manufacturers an extent to which those needs will be met. 27 references.

06 Properties

REFER ALSO TO CITATION(S) 06080048977

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0702 Radiation Sources

REFER ALSO TO CITATION(S) 07020048377

47569 **(GKSS—84/E/14) Comparison of the results of neutron flux and energy measurements with the predictions of theoretical calculations for a coaxial 14 MeV neutron tube.** Bahal, B.M.; Fanger, H.U. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1984. 9p. Nucl. Instrum. Methods Phys. Res., Sect. A (1 Mar 1984) v. 220(2/3) p. 517-524.

The ^{93}Nb(n,2n)/^{90}Zr(n,2n) reaction method has been extended to investigate the axial alteration of the 14 MeV neutron spectrum and flux in a neutron tube having cylindrical acceleration structure. The resulting data are compared with recently published calculations where the only free parameter T(x), describing the combined effect of target thickness and ion current density in parallel to the target cylinder axis, has been adjusted. Thus, besides the information obtained about neutron distributions, indirect conclusions may be drawn as to the ion-focussing properties of the system.

47570 **(LA-tr—84-41) Industrial neutron generators for activation analysis.** Yevdokimov, Yu.B.; Ivanov, A.S.; Komorin, L.V.; Solnyskkov, A.I.; Surovtsev, Yu.P.; Fedotov, M.T.; Tsepakin, S.G. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. Translated from Yadernofizicheskiye metody analiza veshchestva; Atomizdat, Moscow, USSR, 1971, pp 269-294. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85001313.

In designing neutron generators for series production, special attention is paid to reducing the size and weight of the unit, reliability of operation with simplicity of control, maximum utilization of standard units, and workability and cost of a structure. An experimental series of neutron generators NG-160A has been produced. The pilot samples of generators IG-150 have been manufactured and tested. Neutron generators NG-160A and NG-200-U are modified designs of previously manufactured generators NG-160 and NG-200. Descriptions are given of neutron generator NG-160A, NG-150, and NG-200-U. Neutron generation based on mixed deuterium-tritium beams operating in pulsed and stationary conditions is discussed, as are neutron generators with sealed vacuum tubes for industry and scientific research. An investigation of output parameters of the NGI-5 pulse neutron generator is reported. (LEW)

47571 **Step brazing a multi-target TRAX.** Berger, D.D. (Lawrence Livermore National Lab., CA). *Welding Journal (Miami);* 41-43(Oct 1983). Contract W-7405-ENG-48.

Fabrication of a target holder for a multi-target transmission anode x-ray tube (TRAX) involved joining of five different materials. The TRAX will generate a nearly mono-energetic x-ray beam useful for instrument calibration and dosimetry studies. Each of three different targets will provide a different energy. The design will allow the experimenter to place a different target in front of the electron beam without breaking vacuum each time. The procedure is described for attaching three 12.7 mm (1/2 in.) diameter targets - made of tungsten, gold and uranium 238 (D-38) - to an OFHC copper support bar. The joining of the copper bar to a welded stainless steel bellows and flange is also described.

0703 Isotopic Power Supplies

47572 **(LA—10096-MS) Experimental investigations of ^{238}Pu behavior in soil columns.** Nelson, G.B.; Herrera, B.; Stalnaker, N.D.; Coffelt, K.P.; Patterson, J.H.; Heaton, R.C.; Matlack, G.M. (Los Alamos National Lab., NM (USA)). May 1984. Contract W-7405-ENG-36. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84016981.

Two series of experiments were conducted to study the transport of plutonium through soils. The first series involved deposition of small quantities (2.0 to 3.5 mg) of particulate ^{238}Pu oxide on soil columns containing silt loam soil. When deionized water was allowed to percolate through the columns, plutonium was released into the drainage at the rate of 8 to 15 pg/day. During the 6.8-y experiment, the total amount of plutonium released into the soil drainage amounted to less than 0.01% of the original source. Analysis of the soil as a function of depth at the end of the experiment revealed that more than 99% of the deposited source remained in the uppermost fraction (2.8 cm) of the column. The second series of experiments was performed by pumping water containing plutonium through columns of soil and comparing the amount of plutonium in the column effluents to that in the feed. For a loamy sand soil, the plutonium content of the effluent reached a steady state of 5% of the feed after 500 days. Analysis of the soil at the end of the experiment (1200 days) showed the columns to be approximately 50% saturated. Saturation of the soil with plutonium would require 13 μg/g and 6.6 y at the feed rate used (averaged of 1.2 μg/g into 300 g of soil).

08 HYDROGEN

0801 Production

REFER ALSO TO CITATION(S) 08010047308, 48305

47573 **(LA-UR—84-2188) Use of oxides in thermochemical water-splitting cycles for solar heat sources. Recent results on the copper oxide cycle.** Jones, W.M.; Bowman, M.G. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 11p. (CONF-840778—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE84015430.

From 7. IEA technical workshop on thermochemical processes; Toronto, Canada (12 Jul 1984).

Additional results on the low temperature reactions for reforming CuO from Cu_2O are presented. These results pertain to the following reaction in the copper oxide cycle: $I_2 + Cu_2O + Mg(OH)_2 = 2CuO + MgI_2(aq) + H_2O$ at 448°K, $\Delta G° = -78.5$. 4 references, 4 figures.

47574 **(TAC—4901901) Quarterly literature review of hydrogen energy. A bibliography with abstracts. Fourth quarter 1975.** 1976. 58p. Technology Application Center, Univ. of New Mexico, Albuquerque, NM 87131. File Number TI84901901.

Thirty-four articles pertaining to hydrogen as a secondary fuel and as an energy carrier are presented. These articles cover production, utilization, transmission, distribution, storage, and safety.

47575 **(TAC—4901902) Quarterly literature review of hydrogen energy: a bibliography with abstracts. First quarter 1975.** 31 Mar 1975. 60p. Technology Application Center, Univ. of New Mexico, Albuquerque, NM 87131. File Number TI84901902.

Fifty-two publications pertaining to hydrogen production, utilization, storage, transmission, distribution, and safety are presented.

47576 **Infrared multiphoton decomposition of phosphine sensitized by silicon tetrafluoride.** Blazejowski, J.; Lampe, F.W. (Pennsylvania State Univ., University Park). *Journal of Physical Chemistry;* **88**: No. 8, 1666-1670(12 Apr 1984). Contract AC02-76ER03416.

The decomposition of PH_3, sensitized by the multiphoton absorption of unfocussed infrared laser radiation by SiF_4, has been studied in the fluence range of 0.2-0.6 J/cm^2 and over a total pressure range of 1-16 torr. Absorption of radiation at 1025.3 cm^{-1} results in the formation of H_2 and a solid deposit which is probably composed of polymeric phosphorus hydrides of formula (PH)/sub x/. No significant amount of gaseous phosphorus compounds were detected, although it is possible that trace amounts of $P_2(g)$ were formed. The effects of initial composition, pressure, fluence, and presence of foreign gases (He, N_2) on the yields of PH_3 decomposition and H_2 formation were examined. A mechanism is proposed which involves absorption of laser energy by SiF_4, followed by collisional energy transfer to PH_3 and subsequent unimolecular decomposition of PH_3 to PH and H_2. The mechanism is shown to be in reasonable accord with the experimental data.

0802 Storage

REFER ALSO TO CITATION(S) 08020047574, 47575

0803 Transport

REFER ALSO TO CITATION(S) 08030047574, 47575

0805 Safety

REFER ALSO TO CITATION(S) 08050047574, 47575

0806 Industrial And Commercial Use

REFER ALSO TO CITATION(S) 08060047574, 47575

09 OTHER SYNTHETIC AND NATURAL FUELS

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 09012047276, 47585

47577 **(BNL—51799) Fischer-Tropsch synthesis of hydrocarbons.** Lampert, A.; Erickson, J.; Smiley, B.; Vaughan, C. Sep 1983. Contract AC02-76CH00016. 55p. NTIS, PC A04/MF A01; GPO Dep. File Number DE84017481.

The performance of an iron-copper Fischer-Tropsch catalyst was studied in a slurry CSTR at 227°C and 790 kPa (100 psig). Catalyst performance was similar to other iron-based catalysts studied previously with respect to conversion of CO, conversion of CO + H_2, and to the product distribution. CO conversion increased with decreasing space velocity, ranging from approximately 60% at 1570 h^{-1} to over 90% at 488 h^{-1}. The H_2 to CO usage ratio was approximately 0.7, indicating that the catalyst is a good water-gas shift catalyst as well as a Fischer-Tropsch catalyst. Reaction products could be described by a Flory distribution with a chain growth probability (α) of 0.67, which is in the gasoline range. In some runs, methanol was added continuously to the reactor feed, but instead of being incorporated into the reaction, the methanol oxidized and deactivated the catalyst. 31 references, 12 figures, 10 tables.

47578 **(NP—4901848) Vapor-liquid equilibrium data on water-substitute gas components: N_2-H_2O, H_2-H_2O, CO-H_2O, H_2-CO-H_2O, and H_2S-H_2O.** Gillespie, P.C.; Wilson, G.M. Apr 1980. 38p. Gas Processors Association, 1812 First Place, Tulsa, OK 74103. File Number TI84901848.

Project 758, initiated in 1976, comprises an experimental program to generate phase equilibrium data on gaseous components with water. Prior to formulating the project, a literature survey reported in RR-36 was conducted to determine the extent and quality of existing data in the area. One conclusion resulting from the survey is limited data exist for water-hydrocarbon systems and their quality varies from average to poor. Therefore, an extensive data development program is envisioned. Initial efforts to develop an experimental method to acquire accurate data rapidly have proved unsuccessful to date, thus delaying data generation. Consequently, the data summarized in the ensuing RR-41 were obtained by established, classical techniques for measuring phase equilibria. With the exception of hydrogen sulfide, the four gaseous components studied in this investigation are related primarily to substitute gas production. However, investigations currently in progress or planned will include natural gas and associated components as well as substitute gas constituents with water. The ultimate goal of the project is to provide adequate data from which existing correlations capable of predicting water-phase equilibria may be improved significantly, or if desirable, new models may be developed. 3 references, 11 figures, 6 tables.

47579 **(PB—84-184969) Methane from biomass and waste program. Task 1. Evaluation of the Lake Apopka Natural Gas District. Report for May 1982-December 1983.** Warren, C.S.; Bruderly, D.E.; Angelieri, M.; Bilello, L.J.; Bucalo, S. Jan 1984. 304p. NTIS, PC A14/MF A01.

This report presents the findings of a study undertaken to evaluate the economics and technical feasibility of producing pipeline quality methane from biomass in an area of central Florida. The study involved land-use mapping, assessment of biomass production potential, and evaluation of base case and advanced biomass-to-methane systems. Economic evaluations were performed to identify major components which impact on the total gas production cost. A levelized cost model including allowance for product development costs was utilized. Areas of further research needs were identified and discussed.

47580 **(PB—84-204916) Bioenergy from farm wastes and/or by farm wastes for rural development.** Maramba, F.D.S. (United Nations Industrial Development Organization, Vienna (Austria)). 20 Feb 1984. 12p. NTIS, PC E03/MF E01.

Presented at Technical Congress held in Conjunction with the Third International Fair - Technology for the People, Manila, Philippines, 23-25 November 1983.

Topics covered include: biogas from manure; rice husks; energy plantation on wastelands; straight hydrous alcohol as substitute engine fuel; straight crude coconuts oil as substitute for diesel fuel. Additional references are technology transfer, appropriate technology, fermentation, renewable energy, composting, and biomass.

47581 **(PB—84-204999) Gas producers technology for rural applications.** Cruz, I.E. (United Nations Industrial Development Organization, Vienna (Austria)). 29 Feb 1984. 9p. NTIS, PC A02/MF A01.

Presented at Technical Congress held in Conjunction with the Third International Fair - Technology for the People, Manila, Philippines, on 23-25 November 1983.

This is a UNIDO publication on producer gas applications in rural areas. Topics covered include: (1) use of such gas which is produced by the incomplete combustion of carbonaceus and cellulose solid fuels, for direct heating as in furnaces, in crop drying, and as engine fuel to provide shaft power; (2) cooling and cleaning of producer gas in preparation for use as fuel for internal combustion engines; and (3) required equipment; chemical reactors; gasification systems.

47582 **(SERI/TR—231-2427) Fuel options from microalgae with representative chemical compositions.** Feinberg, D.A. Jul 1984. Contract AC02-83CH10093. 30p. NTIS, PC A03/MF A01; GPO Dep. File Number DE84013019.

Representative species of microalgae are examined with respect to their reported chemical compositions. Each species is analyzed under a variety of culture conditions, with the objective being to characterize an optimum mixture of fuel products (e.g., methane, ethanol, methylester) which should be produced by the particular species. Historically the emphasis has been on the entire algal cell mass. Using the reported chemical composition for the representative species under specific sets of growth conditions, some conclusions can be drawn about the preferred fuel product conversion routes that could be employed. 10 references, 7 figures, 12 tables.

47583 **Computer modeling of the Battelle high throughput biomass gasification system.** Appelbaum, H.R.; Feldmann, H.F.; Paisley, M.A. (Battelle Columbus Laboratories, Columbus, OH). pp 341-345 of Technical economics, synfuels and coal energy symposium. Dicks, J.B. New York, NY, USA; A.S.M.E. (1984). (CONF-831111—).

From ASME winter annual meeting; Boston, MA, USA (13 Nov 1983).

Battelle-Columbus is developing under DOE sponsorship a novel biomass gasification process. Its features and benefits have been discussed previously. These features allow biomass gasification utilizing this process to produce medium-Btu gas with a significant cost advantage over either natural gas or fuel oil. Operational data for the integrated process research unit (PRU) have been published and cost projections based upon previous data indicated favorable economics. However, since the process is continually evolving, the projected economics are a moving target. For example, more recent work has focused on the substitution of recycle product gas for steam as a gasifying agent and testing a reactor modification that has significantly increased carbon conversion in the gasifier. These operational modifications can result in increased gas production and by-product steam in the same size plant, allowing favorable re-evaluation of the process.

0902 Alcohol Fuels

REFER ALSO TO CITATION(S) 09021048149

47584 **(DOE/CS/66001—5) Technical and economic assessment of processes for the production of butanol and acetone. Phase two: analysis of research advances. Energy Conversion and Utilization Technologies Program.** Aug 1984. Contract AI01-81CS66001. 142p. (JPL—9950-928). NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85000320.

The initial objective of this work was to develop a methodology for analyzing the impact of technological advances as a tool to help establish priorities for R and D options in the field of biocatalysis. As an example of a biocatalyzed process, butanol/acetone fermentation (ABE process) was selected as the specific topic of study. A base case model characterizing the technology and economics associated with the ABE process was developed in the previous first phase of study. The project objectives were broadened in this second phase of work to provide parametric estimates of the economic and energy impacts of a variety of research advances in the hydrolysis, fermentation and purification sections of the process. The research advances analyzed in this study were based on a comprehensive literature review. The six process options analyzed were: continuous ABE fermentaton; vacuum ABE fermentation; Baelene solvent extraction; HRI's Lignol process; improved prehydrolysis/dual enzyme hydrolysis; and improved microorganism tolerance to butanol toxicity. Of the six options analyzed, only improved microorganism tolerance to butanol toxicity had a significant positive effect on energy efficiency and economics. This particular process option reduced the base case production cost (including 10% DCF return) by 20% and energy consumption by 16%. Figures and tables.

47585 **(WAOENG—84-57) Decision guide to farm fuel production: ethanol, methanol, or vegetable oils.** Kerstetter, J.D. Sep 1984. 37p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85000056.

The purpose of this paper is to inform farmers of the choices they have today regarding production of motor vehicle fuels. Its intent is to inform farmers of what is involved in producing an alternative fuel, its compatibility with existing engines, the costs involved, and the markets for the fuel and any by-products. This paper is not a how-to-do-it manual or a policy document. Some of the data has been developed from the Appropriate Technology Small Grants Program managed by the Washington State Energy Office. Part One provides background information on Washington's fuel use patterns, highlighting the agricultural sector. In Part Two, general considerations common to all alternative fuels are covered. Part Three contains three detailed discussions of the alternative fuels most favored by Washington farmers for production and use - ethanol, vegetable oils, and methanol. The Appendix contains a brief summary of the 11 ethanol projects in Washington funded as a result of the Appropriate Technology Small Grants Program. 5 references, 12 figures, 2 tables.

0904 Solid Waste And Wood Fuels

REFER ALSO TO CITATION(S) 09040048461

47586 **(AD-A—140126/4) Utilization of refuse derived fuels by the United States Navy.** Lehr, D.L. Jul 1983. 116p. NTIS, PC A06/MF A01.

The Resource Conservation and Recovery Act and the Safe Drinking Water Act are forcing those in charge of landfills to adhere to more stringent operating standards. This, along with the growing scarcity of landfill availability, makes the use of landfills less desirable for solid waste disposal. As such, new disposal methods that are environmentally safe and economically practical must be found. One alternative, that is not really new but which has gained renewed interest, is incineration. The Resource Conservation and Recovery Act also requires that government agencies should direct their installations to recover as many resources as possible. Therefore if incineration is to be implemented, heat recovery should be incorporated into the system. There are several processes available to convert raw refuse into a fuel for use in a heat recovery system. Refuse derived fuels (RDF) can be in the form of raw refuse, densified refuse, powdered refuse, gas, or pyrolytic oil. The only form of RDF that is economically feasible for systems designed to process less than 200 TPD (tons per day) is raw refuse. Most Navy bases generate far less than 200 TPD of solid waste and therefore the Navy has focused most of its attention on modular heat recovery incinerator (HRI) systems that utilize raw refuse as fuel.

47587 (AD-A—142314/4) Densified refuse-derived fuels-overview of production processes and combustion characteristics. Final report October 1981-September 1982. Swaidan, B.E. (Naval Civil Engineering Lab., Port Hueneme, CA (USA)). May 1984. 32p. (NCEL-TN—1695). NTIS, PC A03/MF A01.

A literature search was conducted to assess the feasibility of utilizing densified refuse-desired fuel (d-RDF) for the production of hot water and steam in Navy boilers. This report also includes the Air Force efforts in adapting d-RDF technology such as manufacturing processes, storage, shipping, and burning characteristics. Based on experiences in utilizing d-RDF to this date, the technology is available, the burning characteristics are very encouraging, and the economic feasibility would be enhanced with local production sites. Further developments in multi-fuel design specifications, and performance testing will promote the utilization of d-RDF.

47588 (TVA/PUB—84/72) 44 power service county forest products industry industrial wood and bark residue estimate. (Tennessee Valley Authority, Norris (USA). Div. of Land and Forest Resources). May 1982. 36p. NTIS, PC A03/MF A01. File Number DE85900075.

Industrial wood and bark residues produced and unused by the forest products industry in 44 power service area counties were estimated giving complete coverage for the 170 power service counties and the 201-county watershed and power service area. The data were adjusted to 1979 base year and put in the same format as the residue data collected in 1980 appearing in Technical Note B-45. The data in this analysis are expressed in oven-dry tons although the information in the county data tables are given in oven-dry and initial condition tons. Mississippi counties have a commanding influence on the area. They average 50,000 tons of residue produced while the remaining counties average 10,000 tons. The unused residue in the Mississippi county is more than the total residue produced in the average remaining counties. Clearly the area to concentrate time and efforts would be in Mississippi.

0905 Liquid Waste Fuels

47589 (PB—84-201342) Combustion of waste oil and emission measurements. Pereira, M.B.R.; Scott, D.W.; Simmonds, A.; Zolghadr, M. (Warren Spring Lab., Stevenage (UK)). 1983. 38p. (LR—479(AP)-M). NTIS, PC E04/MF E04.

Waste oil-fired indirect air heaters (49-108 kW heat output) have been tested under laboratory and field conditions. The chemical composition of a range of waste oils was determined for selected metals, sulphur and chlorine and these were used to determine and validate emission and deposition factors. Lead was identified as an important pollutant. A procedure has been given for determining chimney heights for waste oil burning appliances which should ensure acceptable ambient pollutant concentrations.

13 HYDRO ENERGY

1301 Resources And Availability

REFER ALSO TO CITATION(S) 13010047308, 47420

1302 Site Geology And Meteorology

47590 (AD-A—142325/0) Microgravity survey of Wilson Dam Powerplant Switchyards, Florence, Alabama. Final report June 1983-January 1984. Butler, D.K.; Yule, D.E. (Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Geotechnical Lab.). Apr 1984. 33p. (WES-MP-GL—84-2). NTIS, PC A03/MF A01.

Results of a microgravity survey at Wilson Dam Power Plant Switchyard, Florence, Alabama, are presented. The survey consisted of 288 gravity stations, with approximately 25% of the stations reoccupied during the survey. Objectives of the survey were to detect any anomalous zones in the switchyard foundation which might be indicative of shallow cavities. At least 75% of the downstream switchyard area has no significant gravity anomalies. In the remaining area, several gravity anomalies are identified which could be indicative of subsurface cavities. If the anomalies are due to cavities, the probable depth range is 5 to 18 ft to the center of the feature. Most of the switchyard structures are in the area free from significant anomalies.

1305 Economics And Management

47591 (DOE/R8/07017—T1) State initiative small scale hydro grant in Colorado. Eighth quarterly and final report. Anderson, O.A. 16 Aug 1982. Contract FG48-80R807017. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84015415.

The closing activities of the Small Scale Hydro Office are described as follows: barriers and incentives, publications, conferences, FERC filings, clearinghouse, and financial status. (MHR)

47592 (GAO/RCED—84-126) Bureau of Indian Affairs' participation in a proposed hydroelectric facility at Kootenai Falls, Montana. (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). 11 Jul 1984. 30p. US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760. File Number TI85900086.

Report to The Honorable Max Baucus, United States Senate.

In 1980 the Bureau of Indian Affairs (BIA) agreed with a group of seven electric cooperatives that it would pay up to a 10.5% share of the costs to determine the feasibility of, and obtain a construction and operation license for, a proposed hydroelectric generating facility at Kootenai Falls, Montana. This report discusses how the BIA improperly spent Flathead Indian Reservation Irrigation and Power Project revenues and did not report to congressional appropriations committees its reprogramming of irrigation and power system construction funds to pay a portion of its share of Kootenai Falls participation expenses. Also, the Flathead project's financial system was not in compliance with two of the Comptroller General's internal control standards. The Department of the Interior has initiated or plans actions to correct the problems identified in this report.

47593 (WAOENG—84-35) Small-scale hydroelectric project development in Washington State. McCoy, G.A.; Lyons, K.; Kinnear, N. Sep 1984. Contract FG06-80R001001. 71p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85000054.

The immediate past and present hydropower development climate within Washington State is summarized. Insight is provided into the technical, land use, and environmental barriers and constraints which limit the widespread development of our seemingly abundant renewable hydropower resource. Particular emphasis is placed upon the critical role played by regional power and energy forecasts and the resultant effect on estimated utility avoided energy costs due to changes in the duration and magnitude of projected regional electrical deficits. Eighteen small and micro-scale hydroelectric projects which have recently begun operation in Washington State are examined to show typical project design features, turbine/generating equipment, environmental constraints and mitigation approaches, utility power purchase rates, and project installation costs. The Northwest manufacturers and distributors of small and micro-scale water turbine and utility interface equipment are highlighted. This section provides information on the types of equipment available, illustrates operating characteristics, and summarizes the literature, services, and assistance available from each manufacturer. A listing of publications which are useful to those in the hydroelectric development community is provided. The documents are classified into hydroelectric project licensing and permitting, resource potential, environmental impacts, cost estimating, financing, power purchase contract, avoided costs and utility interconnection, site assessment and project design, turbine/generating equipment, and streamflow information.

14 SOLAR ENERGY

REFER ALSO TO CITATION(S) 14000047632

1403 Economics

REFER ALSO TO CITATION(S) 14030047606

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 14050047579, 47580, 47581, 47582, 47583, 47584, 47585, 47588, 47607, 47998, 48301

47594 (AD-A—141813/6) Schottky barrier photoelectrodes with a variable barrier height. Final report 26 September 1983-25 March 1984. Rauh, R.D.; Rogers, D.R. May 1984. 31p. (C—757). NTIS, PC A03/MF A01.

The purpose of this research is to investigate the properties of Schottky barriers formed between semiconductors and ion insertion compounds having continuously and reversibly variable work functions. In Phase I, the diode p-Si/M(x)WO3 (M = H, Li) was studied. Li(x)WO3 thin films, prepared by vacuum evaporation or sputtering, showed work functions spanning the range 4.2-5.2 eV for x = 0 to 0.4. Electrical measurements on solid state diodes employing Li(x)WO3 layers revealed a barrier height modulation of 0.06V for this range, limited by significant Fermi level pinning. Photoelectrochemical measurements of H(x)WO3 coated p-Si electrodes showed that the ion insertion compound enhanced electrode stability and photoresponse in acidic electrolytes. The band bending in naked and coated p-Si electrodes was measured as a function of applied bias using a new technique assessing saturation photovoltage as the electrode is polarized. The slope of these curves, (dVB/dV), is related inversely to the interface state density, Ds. Ds was significantly reduced by the H(x)WO3 overlayer.

47595 (CONF-840605—1) Herbaceous energy crops: planning for a renewed commitment. Berger, B.J.; Cushman, J.H. (USDOE, Washington, DC; Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85001274.

From Bioenergy '84; Gothenburg, Sweden (18 Jun 1984).

In 1984, the US Department of Energy's Biomass Energy Technology Division (BETD) began a new program of research on the production of herbaceous crops for energy. In addition to the new Herbaceous Energy Crops (HEC) Program, ongoing BETD programs involve woody and aquatic energy crops. The goal of the HEC Program is to provide the technology base that will allow industry to develop commercially viable species and systems in order to produce herbaceous biomass for fuels and energy feedstocks. The program will concentrate on crop types that can contribute the most to energy supplies while minimizing the impact of producing energy from crops on food production and the environment. Research in the HEC Program will focus on crops suitable for marginal croplands and on winter crops that can be grown between plantings of conventional crops. 1 table.

47596 (DOE/ER/10795—T1) MBE growth of $CuInSe_2$ on CdS: initial stages. Clark, A.H.; Unertl, W.N. 29 Sep 1981. Contract FG02-80ER10795. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84017324.

Realization of the potentially high solar conversion efficiencies of $CuInSe_2$/CdS heterojunctions has been hindered by a lack of knowledge and control of stoichiometry as well as cadmium diffusion in the $CuInSe_2$ layer. In an attempt to understand these effects, we have used in situ Auger electron spectroscopy (AES) and electron energy loss spectroscopy (EELS) to study the early growth stages of $CuInSe_2$ on to (0001B) CdS (Ts = 300°C) using molecular beam epitaxy (MBE). We find that 25A thick $CuInSe_2$ layers show bulk-like AES and EELS spectra, although several atomic percent cadmium is always present on the surface. The energy loss peaks (12.0 +- 0.5 eV and 21.5 +- 0.5 eV) have widths of about 5 to 6 eV compared to about 3 eV for CdS loss peaks (instrument limited). In order to produce layers with no detectable cadmium at the surface, the $CuInSe_2$ must be several hundred Angstroms thick. The metallurgical junction formed at T/sub sub/ = 300°C is no wider than 10 to 20 A, while the junction formed at T/sub sub/ = 400°c is about 40 to 50 A wide.

47597 (DOE/ET/20356—12) Module Utilization Committee. Final report. (Jet Propulsion Lab., Pasadena, CA (USA)). Mar 1984. Contract AI01-76ET20356. 20p. (JPL-PUB—84-40). NTIS, PC A02/MF A01; GPO Dep. File Number DE85000331.

Photovoltaic collector modules were declared surplus to the needs of the US Department of Energy. The Module Utilization Committee was formed to make appropriate disposition of the surplus modules. The final report of that committee accounts for that disposition. The membership and activities of the committee are set forth and the results of its activities are reported.

47598 (DOE/ET/20356—17) Polycrystalline silicon study. Low-cost silicon refining technology prospects and semiconductor-grade polycrystalline silicon availability through 1988. Costogue, E.N.; Ferber, R.R.; Lutwack, R. (Jet Propulsion Lab., Pasadena, CA (USA)). 30 May 1984. Contract AI01-76ET20356. 45p. (JPL-PUB—84-41). NTIS, PC A03/MF A01; GPO Dep. File Number DE85000327.

Photovoltaic arrays that convert solar energy into electrical energy can become a cost-effective bulk energy generation alternative, provided that an adequate supply of low-cost materials is available. One of the key requirements for economic photovoltaic cells is reasonably priced silicon. At present, the photovoltaic industry is dependent upon polycrystalline silicon refined by the Siemens process primarily for integrated circuits, power devices, and discrete semiconductor devices. This dependency is expected to continue until the DOE-sponsored low-cost silicon refining technology developments have matured to the point where they are in commercial use. The photovoltaic industry can then develop its own source of supply. Since 1979 the Jet Propulsion Laboratory Technology Development and Application Lead Center (TD and A), now the Program Analysis and Integration Center (PA and I), has periodically examined the availability of refined silicon and the status of the DOE-sponsored low-cost silicon refining technology developments. Three reports have been published, based on surveys conducted by JPL consultants in 1979, 1981, and 1983. This report updates the silicon material availability and market pricing projections through 1988, based on data collected early in 1984. It also overviews the silicon refining industry plans to meet the increasing demands of the semiconductor device and photovoltaic product industries. A section of the report has been devoted to review of the DOE-sponsored technology research for producing low-cost polycrystalline silicon, probabilistic cost analysis for the two most promising production processes for achieving the DOE cost goals, and the impacts of the DOE photovoltaics program silicon refining research upon the commercial polycrystalline silicon refining industry.

47599 (DOE/ET/23042—T2) Amorphous silicon solar cells by hydrogen implantation. Monthly technical status report No. 1, January 1979. (Spire Corp., Bedford, MA (USA)). 1979. Contract AC03-79ET23042. 7p. (MR—10064-O1). NTIS, PC A02/MF A01; GPO Dep. File Number DE84017365.

The purpose of this program is to confirm or disprove that ion implantation can be a useful technique in the preparation of material for an amorphous silicon solar cell. Effort under the program during January 1979 involved the following: development of a technical plan; evaluation of procedures and identification of required fixtures for the fabrication of a standard test cell configuration; development of procedures for the evaluation of material photoconductivity and transmittance characteristics and of test device performance; and consideration of special implantation requirements and initiation of procurement action for necessary implanter modification components.

47600 (DOE/JPL—1012-100) FSA field test annual report, August 1981-January 1984. Weaver, R.W.; Lee, R.H.; Meyer, J.D.; Runkle, L.D. (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Aug 1984. Contract AI01-76ET20356. 35p. (JPL-PUB—84-52). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85000353.

During this reporting period the restructuring plan presented in the previous annual report was modified in response to budgetary pressures. The latter part of the period was marked by further budget reductions, which required a further curtailment of the Flat-Plate Solar Array (FSA) Project's field testing activities. The modified plan was implemented with the following accomplishments: (1) six arrays containing Block IV modules were completed at the Jet Propulsion Laboratory (JPL) site; (2) the portable array data logger was completed and used at both the JPL site and at several non-JPL installations; and (3) a representative sample of Block I, II, and III modules were redeployed to the Goldstone site for continued endurance testing. Those portions of the plan that were modified include: (1) a reduction in the number of Block IV modules deployed; (2) a reduced data acquisition schedule; (3) abandonment of the Table Mountain and Point Vicente sites; and (4) only a sample of the modules from the 12 continental remote sites underwent the final test procedures. Current endurance data are presented for the remaining Block I, II, and III modules. These data indicate that more of these modules have failed or decreased in power output during this period. None of the Block IV modules under test during this period have failed, but 11 of the 155 deployed modules show reduced power output.

47601 (N—84-23027) Effect of diffusion induced lattice stress on the open-circuit voltage in silicon solar cells. Weizer, V.G.; Godlewski, M.P. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1984. 10p. (NASA-TM—83667; E—2110). NTIS, PC A02/MF A01.

It is demonstrated that diffusion induced stresses in low resistivity silicon solar cells can significantly reduce both the open-circuit voltage and collection efficiency. The degradtion mechanism involves stress induced changes in both the minority carrier mobility and the diffusion length. Thermal recovery characteristics indicate that the stresses are relieved at higher temperatures by divacancy flow (silicon self diffusion). The level of residual stress in as-fabricated cells was found to be negligible in the cells tested.

47602 (PB—84-180561) Diffusion of biomass energy technologies in developing countries - second edition. Final report. Jan 1984. 129p. NTIS, PC A07/MF A01.

Library of Congress catalog card No. 82-82005.

This study reviews the factors -- technical, economic, cultural, and political -- that effect the diffusion of biomass-based energy technologies in developing countries. It identifies opportunities and limitations and makes recommendations for improving technology for meeting the energy needs of the rural and urban poor. Methods for technology and innovation diffusion are discussed.

47603 (PB—84-200567) Marine biomass: New York state species and site studies. Annual report 1 December 1981-30 November 1982. Squires, D.F.; McKay, L.B.; Brinkhuis, B.H.; Hanisak, M.D.; Williams, S.L. Oct 1983. 217p. NTIS, PC A10/MF A01.

Sponsored in part by Gas Research Inst., Chicago, IL and New York Gas Group, NY. Prepared in cooperation with Cornell Univ., Ithaca, NY. See also PB84-111392.

This annual report describes the research program and results for the third year of work in the NYS Marine Biomass Program. The overall goal of the Program is to develop the ability to produce reasonably priced methane from marine biomass. The specific objectives for the reported year were to design a biological test farm for marine biomass of sufficient size to permit future experimental research on a two-crop system, provide the necessary biological data to support the test farm design and initiate work necessary to seed the farm. A final design for the biological engineering experimental farm, adapting Oriental concepts to New York conditions, was developed and permits and permissions were secured for placing the farm in Long Island Sound. Additional work was successfully completed to determine the mechanical properties of seaweed, develop seeding techniques and appropriate culture media for high reproductive success of Laminaria gametophytes and young sporophytes prior to transfer to culture ropes.

47604 (SAND—84-7010) Thin-film barriers. Nicolet, M.A. (California Inst. of Tech., Pasadena (USA)). Sep 1984. Contract AC04-76DP00789. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85001952.

The properties and performance of reactively sputtered TiN films used as diffusion barriers have been investigated experimentally. The practical performance of TiN diffusion barriers was tested on both standard and on concentrator solar cells in collaboration with Applied Solar Energy Corporation. In thermal annealing tests, TiN stabilized cells successfully survived treatments as extreme as 1 h at 600°C and 15 min at 700°C. The main problem in these tests was the modest reproducibility. The properties of diffusion barrier layers studied in detail are the contact resistivity and the thermal oxidation behavior. Untreated reactively sputtered TiN films have a contact resistivity of $\sim 3 \times 10^{-4}\ \Omega\ cm^2$ on n^+ Si and $\sim 1.5 \times 10^{-5}\ \Omega\ cm^2$ on p^+ Si. Upon annealing, the two values converge to $6 \times 10^{-5}\ \Omega\ cm^2$. The thermal oxidation of TiN in dry and wet ambient and of HfN in dry ambient proceeds in a laterally uniform fashion, resulting in a transformation to TiO_2 and HfO_2. The kinetics of these reactions has been determined. Ancillary, reactively sputtered TiN barriers improved the thermal stability of Al contacts to Ni and Pd silicide Schottky barriers on Si and of Ti/Pd/Au contacts on standard Au-Ge-Ni alloyed ohmic contacts to GaAs.

47605 Window losses and current mismatch computer modeling studies in AlGaAs-GaAs cascade solar cell. Lamorte, M.F.; Abbott, D.H. (Research Triangle Inst., Research Triangle Park, NC). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Electron Devices;* ED-**30**: 1313-1322(Oct 1983). Contract FG02-79ET00083.

Two-junction AlGaAs-GaAs cascade solar cell computer modeling studies are reported for operation at 300 K, Am 0, and unity solar concentration. An optimized design is obtained by maximizing conversion efficiency. Device performance characteristics are investigated by separately varying the structure parameters. These effects are described through a discussion of the excess current and power utilization ratio parameters, both of which are related to current mismatch between top and bottom cells. Window layer losses are shown to contribute the major loss factors in an optimized designed cascade solar cell using this materials system. The study concludes by showing that if the bulk and surface recombination losses in the window layer are removed, conversion efficiency exceeding 31 percent is attainable.

1406 Photovoltaic Power Systems

47606 **(DOE/ET/20356—16) Stand-alone flat-plate photovoltaic power systems: system sizing and life-cycle costing methodology for federal agencies.** Borden, C.S.; Volkmer, K.; Cochrane, E.H.; Lawson, A.C. (Jet Propulsion Lab., Pasadena, CA (USA)). May 1984. Contract AI01-76ET20356. 95p. (JPL-PUB—84-37). NTIS, PC A05/MF A01; GPO Dep. File Number DE85000328.

A simple methodology to estimate photovoltaic system size and life-cycle costs in stand-along applications is presented in this document. It is designed to assist engineers at government agencies in determining the feasibility of using small stand-alone photovoltaic systems to supply ac or dc power to the load. Photovoltaic system design considerations are presented as well as the equations for sizing the flat-plate array and the battery storage to meet the required load. Cost effectiveness of a candidate photovoltaic system is based on comparison with the life-cycle cost of alternative systems. Examples of alternative systems addressed herein are batteries, diesel generators, the utility grid, and other renewable energy systems. A companion document, Flat-Plate Photovoltaic Power Systems Handbook for Federal Agencies (Reference 10), is recommended for discussion of issues for evaluating the viability of potential photovoltaic applications; descriptions of present photovoltaic system applications; synthesis of lessons learned from photovoltaic system design, installation, and operation; and identification of procurement strategies for federal agencies.

47607 **(DOE/JPL—1012-98) Proceedings of the Flat-Plate Solar Array Project Research Forum on the design of flat-plate photovoltaic arrays for central stations.** (Jet Propulsion Lab., Pasadena, CA (USA)). 1983. Contract AI01-76ET20356. 315p. (JPL-PUB—84-44; CONF-831290—). NTIS, PC A14/MF A01; GPO Dep. File Number DE85000332.

From Design of flat-plate photovoltaic arrays for central stations research forum; Sacramento, CA, USA (5 Dec 1983).

The Flat-Plate Solar Array Project, managed by the Jet Propulsion Laboratory for the US Department of Energy, has focused on advancing technologies relevant to the design and construction of megawatt-level central-station systems. Photovoltaic modules and arrays for flat-plate central-station or other large-scale electric power production facilities require the establishment of a technical base that resolves design issues and results in practical and cost-effective configurations. The Central Station Research Forum addressed design, qualification and maintenance issues related to central-station arrays derived from the engineering and operating experiences of early applications and parallel laboratory research activities. Technical issues were examined from the viewpoint of the utility engineer, architect-engineer and laboratory researcher. The forum included presentations on optimum source-circuit designs, module insulation design for high system voltages, array safety, structural interface design, measurements and array operation and maintenance. The Research Forum focused on current capabilities as well as design difficulties requiring additional technological thrusts and/or continued research emphasis. Session topic summaries highlighting major points during group discussions, identifying promising technical approaches or areas of future research, are presented.

47608 **(N—84-23021) Study of solar array switching power management technology for space power system.** Cassinelli, J.E. Sep 1982. 33p. (NASA-CR—167890). NTIS, PC A03/MF A01.

This report documents work performed on the Solar Array Switching Power Management Study. Mission characteristics for three missions were defined to the depth necessary to determine their power management requirements. Solar array switching concepts were identified that could safisfy the mission requirements. These switching concepts were compared with a conventional buck regulator system on the basis of cost, weight and volume, reliability, efficiency and thermal control. For the missions reviewed, solar array switching provided significant advantages in all areas of comparison.

47609 **(SAND—84-1167) Compilation of Sandia papers contributed to the 17th IEEE Photovoltaic Specialists Conference.** Burgess, E.L. (ed.). (Sandia National Labs., Albuquerque, NM (USA)). Aug 1984. Contract AC04-76DP00789. 148p. (CONF-840561—Exc.). NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE84017456.

From 17. IEEE photovoltaic specialists conference; Orlando, FL, USA (1 May 1984).

Separate abstracts were prepared for 11 papers in this compilation. Eleven other papers are included in the proceedings that had been previously indexed for EDB.

47610 **(SAND—84-7162C) Thermal design requirements of a 50-kW zinc/redox flow battery for solar electrical energy storage.** Selman, J.R.; Wu, H.; Hollandsworth, R.P. (Illinois Inst. of Tech., Chicago (USA). Dept. of Chemical Engineering; Lockheed Palo Alto Research Labs., CA (USA)). Sep 1984. Contract AC04-76DP00789. 24p. (CONF-841121—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84017088.

From AIChE annual meeting; San Francisco, CA, USA (25 Nov 1984).

The conceptual engineering design of a large-scale zinc/redox battery for solar electrical energy storage involves the management of considerable heat flows. This is due to the large heat-of-crystallization of sodium ferrocyanide decahydrate produced during discharge as well as the usual reversible and irreversible cell-reaction heat effects. A discussion of practical design implications is presented.

1407 Solar Thermal Power Systems

REFER ALSO TO CITATION(S) 14070047879

47611 **(DOE/DP/00789—T100) Plant operation report and daily evaluation summary. SSPS monthly data, April 1984.** 1984. Contract AC04-76DR00789. 80p. NTIS MF A01; 2; GPO Dep. File Number DE84017150.

Operation and maintenance highlights and test and evaluation highlights are presented for the Small Solar Power Systems (SSPS) Central Receiver System (CRS) and Distributed Collector System (DCS). The major portion of this report consists of the following plant statistics; monthly operation summary for April 1984; CRS daily operation summary; DCS daily operation summary.

47612 **(DOE/DP/00789—T101) SESAM-DCS: a computer code for solar system modelling. Analysis report.** Fabry, J.P.; Richel, H.; Lamotte, H.; Vereb, M.; Brusselaers, P. (Societe Belge pour l'Industrie Nucleaire, Brussels). Mar 1984. Contract AC04-76DR00789. 186p. NTIS MF A01; 2; GPO Dep. File Number DE84017148.

The development of the SESAM-DCS code for modeling the Distributed Collector System Solar Plant of Algeria is described. The particular required features of SESAM-DCS are a high speed of execution, a detailed thermohydraulic modelling of the solar system, including thermal inertia and a realistic representation of the regulation and control system of the plant. As it can be run on a APPLE-II personnal computer -much faster than real time- SESAM is thought to be an ideal tool to help the operator of the plant to search for the optimum strategy of operation or to cope with prescribed production patterns. This report presents a detailed analysis of the problems and the solutions used by SESAM. More details on the code will be presented in the How to use of the code. A very special care was devoted to model the static and transient behavior of the piping, the thermal storage and the steam generator.

47613 **(DOE/DP/00789—T102) Plant operation report and daily operation summary. SSPS monthly data, March 1984.** 1984. Contract AC04-76DR00789. 77p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE84017151.

Operation and maintenance highlights and test and evaluation highlights are presented for the Small Solar Power Systems (SSPS) Central Receiver System (CRS) and Distributed Collector

System (DCS). The major portion of this report consists of the following plant statistics: monthly operation summary for March 1984; CRS daily operation summary; and DCS daily operation summary.

47614 **(DOE/JPL—1060-58) Proceedings: fourth parabolic-dish solar-thermal power program review.** (Jet Propulsion Lab., Pasadena, CA (USA)). 1 Feb 1983. Contract AM04-80AL13137. 324p. (CONF-821184—; JPL-PUB—83-2). NTIS, PC A14/MF A01. File Number DE83011247.

From 4. parabolic dish solar thermal power program review meeting; Pasadena, CA, USA (30 Nov 1982).

The primary objective of the review was to present the results of activities within the Parabolic Dish Technology and Applications Development element of the Department of Energy's Solar Thermal Energy Systems Program. The Review consisted of 6 technical sessions, covering Stirling, Organic Rankine and Brayton module technologies, associated hardware and test results to date; concentrator development and progress; economic analyses; and current international dish development activities. Two panel discussions, concerning industry issues affecting solar thermal dish development and dish technology from a utility/user perspective, were also held. These Proceedings contain the texts of presentations made at the review, which are abstracted separately for EDB.

47615 **(DOE/SF/10501—062) 10-MWe solar thermal central receiver pilot plant. Maintenance program.** (Southern California Edison Co., Rosemead (USA)). Feb 1983. Contract FC03-77SF10501. 18p. (STMPO—062). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84017039.

This report is intended to answer two major maintenance related questions: That sufficient resources are programed and budgeted to enable the project to accomplish program objectives and to effectively evaluate and measure performance in order to determine that the condition of the plant property meets departmental objectives. The goal of maintenance is to maximize plant reliability at an optimum cost. Details on the Generation Management System (GMS) plan are given in the appendix of this report.

47616 **(N—84-23034) Thermodynamic model for a central receiver of a solar plant with partial shading of the heliostat field.** Reinkenhof, J. (European Space Agency, 75 - Paris (France)). Sep 1983. 119p. (ESA-TT—807; DFVLR-FB—82-27). NTIS, PC A06/MF A01.

The time dependent loss mechanisms of a heliostat field and a stochastic model for the simulation of partial shading of the heliostat field are discussed. The coupling of the heliostat field with the receiver is reduced to the problem of an aperture covered with directed energy sources and sinks. A two-dimensional normal distribution is selected as the intensity distribution over the aperture. The energy flux can be calculated for any point within the receiver. The local heat flux into the walls of a reveiver with arbitrary geometry is estimated. The case of isothermal walls with re-emitted radiation escaping through the aperture is treated. (ESA)

47617 **(SAND—83-8018) Department of Energy solar-central-receiver annual meeting.** (Sandia National Labs., Livermore, CA (USA)). Sep 1983. Contract AC04-76DR00789. 372p. (CONF-8304125—). NTIS MF A01. File Number DE84000929.

From DOE solar central receiver annual meeting; Albuquerque, NM, USA (26 Apr 1983).

This report presents the highlights of the Department of Energy solar-central-receiver annual meeting held in Albuquerque, New Mexico, on April 26-27, 1983. Some of the papers presented at this meeting are abstracted individually for EDB.

47618 **Assessment of generic solar thermal systems for large power applications.** Apley, W.J.; Bird, S.P. (Pacific Northwest Laboratory, Richland, WA 99352). *Journal of Solar Energy Engineering;* **106**: No. 1, 22-28(Feb 1984).

A comparative analysis of generic solar thermal conversion configurations was performed to evaluate and rank the principal concepts under consideration in the DOE Solar Thermal Power Program. Year-long performance simulations were conducted for the 50- to 200-MWe systems using Barstow, California meteorological and insolation data. Multi-attributable utility methodology was used to rank the eleven concepts.

47619 **A reciprocating solar-heated engine utilizing direct absorption by small particles.** Hull, P.G.; Hunt, A.J. (Energy and Environment Division, Lawrence Berkeley Laboratory, University of California, Berkeley, CA). *Journal of Solar Energy Engineering;* **106**: No. 1, 29-34(Feb 1984).

A new type of reciprocating solar engine utilizing small particles to absorb concentrated sunlight directly within the cylinders is described. The engine operates by drawing an air-particle mixture into the cylinder, compressing the mixture, opening an optical valve to allow concentrated sunlight to enter through a window in the top of the cylinder head, absorbing the solar flux with the particles, and converting the heat trapped by the air-particle mixture into mechanical energy with the downward stroke of piston. It differs from other gas driven heat engines using solar energy in three main respects. First, the radiant flux is deposited directly in the working fluid inside the cylinder; second, the heat is directed to the appropriate cylinder by controlling the solar flux by an optical system; third, the gas is heated during a significant portion of the compression stroke. The thermodynamic efficiency of the engine is calculated using an analytical model and is compared to several other engine cycles of interest.

47620 **Instantaneous flux distribution on a solar central receiver.** Vant-Hull, L.L. (Energy Laboratory, University of Houston, Houston, Texas). *Journal of Solar Energy Engineering;* **106**: No. 1, 39-43(Feb 1984).

An important aspect in the design of a Solar Central Receiver System is the distribution of the solar flux on the receiver. In this paper, the authors present information for the Central Receiver Pilot Plant, Solar One, at Barstow, California, on the time variation of the receiver flux during cloud passage, at sunrise and during the day.

47621 **Thermal analysis of a solar advanced water/steam receiver.** Yeh, L.T.; Wiener, M. (Engineering Technology Department, Fossil Power Generation Division, Babcock & Wilcox Company, Barberton, Ohio). *Journal of Solar Energy Engineering;* **106**: No. 1, 44(Feb 1984).

The Department of Energy and Sandia Laboratories have sponsored the development of a conceptual design for a 100-MWe solar advanced water/steam receiver that is cost-effective and will perform within a practical and reliable power generation system. The design requirements and the basic features of receiver are described. This paper presents the methods used to estimate the receiver's thermal efficiency and predict its thermal hydraulic performance. The receiver under consideration is external with screen tubes using a forced recirculation system. Thermal efficiency of the receiver at the design point is estimated at 89.2 percent. Effects due to changing ambient conditions, such as ambient temperature and windspeed, and changes of solar incident power are also presented.

47622 **10-MWe solar thermal central receiver pilot plant.** Bartel, J.J.; Skvanna, P.E. (Sandia National Laboratories, Livermore, CA). *Journal of Solar Energy Engineering;* **106**: No. 1, 50-58(Feb 1984).

The Solar One Project is the world's largest solar electric generating station. This pilot-scale research and development experiment is a cooperative effort of government and private industry to demonstrate technical feasibility, economic potential, and environmental acceptability of the solar thermal central receiver concept. The project, which is formally known as the 10-MW Solar Thermal Central Receiver Pilot Plant, has been constructed in the Mojave Desert on 130 acres of Southern California Edison Company's Cool Water Generating Station near Barstow, California, and will supply 10 MW of electrical power to the Edison grid. Solar One is a joint project of the Department of Energy (DOE), Southern California Edison (SCE), the Los Angeles Department of Water and Power (LADWP), and the California Energy Commission. The solar portion of the facility was designed and constructed under the direction of the DOE, and the turbine-generator facilities, including the control building, were designed and constructed by SCE. This paper presents an overview of the project, discusses the costs and schedule, highlights the planned test program including operation and maintenance, and briefly discusses the experiences through October 1982.

47623 **International energy agency small solar power systems central receiver system sodium heat transfer system modeling.** Baker, A.F.; Fewell, M.E. (Sandia National Laboratories, Systems Evaluation Division, Livermore, California). *American Society of Mechanical Engineers, [Paper];* **83-WA/SOL-9**: 6(Nov 1983). (CONF-831111—).

From ASME winter annual meeting; Boston, MA, USA (13 Nov 1983).

The sodium heat transfer system of the International Energy Agency (IEA) Small Solar Power Systems (SSPS) Central Receiver System (CRS), which includes the heliostat field, receiver, hot and cold storage vessels, and sodium/water steam generator has been modeled. The computer code SOLTES (Simulator of Large Thermal Energy Systems), developed by Sandia National Laboratories, was used to model this system. Based on data provided to Sandia by the IEA-SSPS/CRS project, the results from SOLTES are compared to measured data. The comparison between measured data and predictions from SOLTES is very good for the day evaluated.

47624 **Solar thermal technologies: potential benefits to U.S. utilities and industry.** Terasawa, K.L.; Gates, W.R. (Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California). *Journal of Energy;* **7**: No. 4, 361-366(Jul 1983).

The net present value of the energy cost savings attributable to solar thermal technologies (STT) in electric utility and industrial process heat applications is estimated for alternative future energy cost scenarios and alternative production cost for solar thermal technology. Under reasonable assumptions regarding future fuel prices and STT production cost, the expected benefits of developing an STT option are significant. Despite these benefits, private investment in STT research and development is unlikely, due to the high level of uncertainty characterizing both future energy prices and the expected returns from such research. Federal participation is required if cost-competitive STT systems are to be available during this century.

1408 Ocean Energy Systems

47625 **(DOE/ET/21002—T11) Ocean Thermal Energy Conversion Project: OTEC support services. Monthly technical status report, October 1-31, 1980.** 14 Nov 1980. Contract AC02-78ET21002. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84017619.

The objective of this project is to provide technical engineering and management support services for the Ocean Thermal Energy Conversion (OTEC) program of the Division of Ocean Energy Systems, DOE. The principal contributions made are outlined for the following tasks: (1) Survey, analysis and recommendation concerning program performance; (2) Program technical monitoring; (3) Technical assessments; (4) OTEC system integration; (5) Environment and siting considerations; and (6) Transmission subsystem considerations.

47626 **An experimental investigation of OCOTEC direct-contact condensation and evaporation processes.** Sam, R.G.; Patel, B.R. (Creare R & D, Inc., Hanover, NH). *Journal of Solar Energy Engineering;* **106**: No. 1, 120-127(Feb 1984).

Heat transfer data are presented for direct-contact evaporator and condenser geometries suitable for Open-Cycle Ocean Thermal Energy Conversion (OCOTEC) applications. Falling turbulent jets and films were tested at typical operating conditions. The flash evaporator performance was relatively constant over the range of conditions tested, with efficiencies as high as 95 percent due to the breakup of the jets (or films) into sprays. The condenser performance was only affected by the jet or film Reynolds number and the steam air content. Condenser heat transfer coefficients of the order of 27 $kW/m^{2\circ}C$ were achieved with jets which were higher than those obtained with films. An empirical correlation was developed for the condenser data after it was shown that none of the existing correlations found in the literature could correlate all of the data trends observed.

1409 Solar Thermal Utilization

REFER ALSO TO CITATION(S) 14090047311, 47997, 48034, 48131

47627 **(AD-A—141839/1) Procedures for acceptance testing of solar energy systems. Final report.** Johnson, D.L.; Joncich, D.M. (Army Construction Engineering Research Lab., Champaign, IL (USA)). Apr 1984. 42p. (CERL-TR-E—192). NTIS, PC A03/MF A01.

This report describes research on the use of simple, low-cost meters for measuring the performance of solar energy systems in Army buildings and for comparing the measured performance with the design specification requirements. The requirements of meters for measuring the performance of solar energy systems were defined. A BTU-Meter for measuring heat transfer was designed, and commercial meters for taking other measurements were obtained. The meters were installed in a solar system in the laboratory and a pilot test of the acceptance test was done. Suggested draft revisions to Corps of Engineers design documents were prepared; designers could use these revisions to include acceptance testing provisions in solar energy system design. It was found that in a short-duration test, simple, low-cost meters can be used to determine whether a newly installed solar energy system is operating as specified. The simplicity of the metering approach allows designers to routinely include metering in the solar system design. The contractor can easily install the meters with the other solar components. Since the meters are so versatile, they can be used continuously for long-term performance monitoring. This gives the designer performance data and allows maintenance personnel to detect and diagnose solar equipment malfunctions. Thus, solar energy system metering can provide a unified, low-cost approach for meeting the wide range of measurement needs of Army solar energy systems.

47628 **(AD-A—142678/2) Development of a modular solar domestic hot water system for Department of Defense barracks. Final technical report.** Joncich, D.M.; Kirts, R.E. (Army Construction Engineering Research Lab., Champaign, IL (USA)). May 1984. 30p. (CERL-TR-E—194). NTIS, PC A03/MF A01.

This report describes the development of a modular concept for solar domestic water heating on Department of Defense (DOD) barracks buildings. In this approach, the solar energy system consists of only two major components: a collector module and a heat-exchanger-pump-storage tank (HPS) module. The collector module is comprised of a three-collector assembly on an aluminum rack for ground or roof mounting, designed for the interconnection of several modules. The HPS module contains the system pump, heat exchanger, thermal storage vessel, expansion tank, controls, Btu meter, and other minor components. A survey of existing DOD barracks indicated that only three discrete sizes of HPS modules would be required to service approximately 75 percent of the entire barracks inventory nationwide. The appropriate size for a given application is selected by a simple, manual procedure which requires a minimum of user input. The features of the installed system include provisions for system filling/draining, freeze protection, and flow balancing. A prototype modular system was placed into operation in March 1983 on an 80-person barracks at the Naval Construction Battalion Center in Port Hueneme, CA. This system, consisting of approximately 900 sq ft of collectors and a 1200-gal tank, is operating properly with a thermal performance near its design goal. Although the system is not economically feasible in current market conditions, its cost effectiveness will improve as fuel prices rise.

47629 **(CONF-830980—) Proceedings of the passive and hybrid solar energy update.** (Rockwell International Corp., Canoga Park, CA (USA). Energy Technology Engineering Center). Nov 1983. Contract AC03-76SF00700. 285p. NTIS, PC A13/MF A01. File Number DE84003039.

From Passive and hybrid solar energy program update conference; Washington, DC, USA (26 Sep 1983).

Progress was reported in this Proceedings on fundamental research and development in radiative cooling, on daylighting systems, and heat transfer. Other reports described new design tools and handbooks, various approaches to transferring technology to sections of the building industry, and the results of monitoring both residential and commercial buildings. The International Energy Agency Task Eight plans and the IEA design tool survey were also covered. On-going research and development efforts continue to address technical challenges in a wide variety of areas, including thermal storage and aperture materials. Separate abstracts were prepared fo papers in this Proceedings.

47630 **(CONF-840954—1) Passive-solar directional-radiating cooling system.** Hull, J.R.; Schertz, W.W. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84016241.

From 9. national passive solar conference; Columbus, OH, USA (23 Sep 1984).

A new type of radiative cooling system is described. The radiator makes use of nonimaging optics and evacuated-tube technology to radiate significant amounts of heat to the 3 K environment of outer space. The nonimaging optics are used to direct the radiation overhead, through the most transparent part of the 8 to 13 micron atmospheric window. The required optical concentration is small, and relatively simple mirror geometries are possible. The evacuated-tube technology is used to attain storage temperatures at or below the freezing point, even when dewpoint temperatures are well above the freezing point. The radiator is passively coupled to an ice or ice/clathrate storage tank by a thermal diode. Storage duration may be either diurnal or seasonal.

47631 **(DOE/CE—0089) Passive solar heating.** Jun 1984. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84016617.

This publication explains in simple terms the basic concepts of passive solar heating systems. Several references to books and pamphlets and a source list are also given.

47632 **(DOE/CE—0099) Five-year technology transfer plan, 1986-1990.** Aug 1984. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84016351.

Under the leadership of the Solar Energy Research Institute (SERI) Office of Research and Technology Applications (ORTA), a multiyear technology transfer program plan was prepared with the input of experts in the technology transfer field, researchers, and members of the buildings industry. Using the multiyear plan as a framework, nine buildings industry trade and professional associations developed plans outlining their roles in the technology transfer process. At the same time, the Division prepared a management plan providing strategies and guidelines for administering the program. To better understand the critical linkages and actors in the technology transfer process, the Division initiated case studies of its earlier efforts to transfer first-generation passive solar heating technologies. The insight provided by the case studies is being used to strengthen the program, update the multiyear plan, and develop an evaluation design. In addition, an experimental University Research Associates Program is in place, and procedures for implementing an Industry Research Associates Program have been developed. The national laboratories have been funded to implement specific technology transfer activities. Interactions between researchers and potential recipients of the research results are increasing in number and leading to more effective idea exchanges and research programs. An initial investigation of passive and hybrid solar energy investment decision-making in nonresidential buildings is nearing completion. A consortium of buildings industry associations is developing and refining a strategy for satisfying its R and D needs using the resources of the federal government, industry, and universities. Likewise, participation of leading industry practitioners and trade and professional associations in current research is continuing.

47633 **(DOE/ET/20643—T1) 35 kW water cooled solar cooling package for Sigler-Faigen parts and supply building computer room, Phoenix, Arizona. Final report.** Biermann, W.J. 1 Dec 1982. Contract FC02-80ET20643. 102p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE84016802.

A description is given of a 35 kW air cooled solar absorption cooling package installed on the Sigler-Faigen warehouse and parts center located in Phoenix, Arizona. The thermal energy required to run the absorption unit is supplied by 88.8 m^2 of linearly curved Fresnel lens solar concentrating tracking collectors. Summaries are given of performance and problems encountered. Appendices include: job site photographs; summarized tabulated daily performance data; E-systems report of on collector performance; and insolation data from NOAA National Weather Service.

47634 **(DOE/ET/20643—T2) 53 kW water cooled solar cooling package for BDP distribution center, Phoenix, Arizona. Final report.** Biermann, W.J. 1 Dec 1982. Contract FC02-80ET20643. 106p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE84017136.

A description is given of the 53 kW water-cooled solar absorption unit installed at the rear of the BDP Arizona Distribution Center, Phoenix, Arizona, for use as the primary means of space comfort cooling. Thermal energy required to run the solar absorption unit is supplied by 133.8 m^2 of concentrating tracking trough-type Acurex collectors. Surplus solar energy is stored in a 9462 liter insulated steel storage tank. Summaries are given of the performance of the system and the problems encountered. Appendices include: job site photographs, summarized tabulated daily performance data; 3M company trip report; and insolation data from NOAA National Weather Service.

47635 **(DOE/R8/01058—T1) Thermochemically powered heat pump and heat storage device. Final report.** Stevenson, P.A.; Hauke, F.E.; Knappenberger, C.; Wehmeyer, K. 29 Jun 1983. Contract FG48-81R801058. 61p. NTIS, PC A04; 3; GPO Dep. File Number DE84015668.

The purpose of this project was to determine the suitability of using sodium sulfide as a medium for energy storage. This report summarizes the findings. Results indicate that the application of sodium sulfide as an inorganic salt hydrate in an absorption heat pump for use with a solar heating system is very reasonable. More work will be required to optimize the design of the system, however, the prospect of an increase in performance of the system make it very attractive to pursue this work. A considerable amount of hardware was built and is working at this time and plans are to continue the testing effort to refine its performance and understanding of the dynamics of the process. More work is still required in the area of configurational optimization. It is believed that the system performance can be improved with some further alterations to the configuration and we hope to find some of these new configurations with further work.

47636 **(LA-UR—84-2638) Experimental study of natural convection heat transfer through an aperture in passive solar heated buildings.** Yamaguchi, Kenjiro. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 7p. (CONF-840954—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE84016828.

From 9. national passive solar conference; Columbus, OH, USA (23 Sep 1984).

The objective of this study is to obtain correlations between natural convection heat transfer through an aperture and temperature difference between the two rooms. A one-fifth similitude model of a two-room building is used. The model is filled with Freon gas to satisfy similarity of the experiment to full-scale conditions in air. The experimental apparatus and experimental techniques are explained. Experimental results are presented in terms of Grashof, Nusselt, and Prandtl numbers. The effects of the height, the width, and the vertical position of the apertures are investigated, as is the effect of the room volume.

47637 **(LA-UR—84-2655) Fast solar load ratio correlations for simple radiant panels and thermosiphoning air panels.** Wray, W.O.; Schnurr, N.M.; Kosiewicz, C.E. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 5p. (CONF-840954—5). NTIS, PC A02/MF A01; GPO Dep. File Number DE84016462.

From 9. national passive solar conference; Columbus, OH, USA (23 Sep 1984).

A set of fast solar load ratio (FSLR) correlations has recently been developed for passive solar heating systems that is appropriate for use on metal buildings either as part of the original construction or as retrofits. The systems considered include simple uninsulated radiant panels and thermosiphoning air panels (TAPs) in which the flow channel is located either in front of or behind the absorber surface. The thermosiphoning air panels may be single or double glazed and the level of insulation between flow channel and living space is arbitrary. TAPs are found to be especially well suited to cold northern climates because of the low steady-state aperture conductances that characterize these systems. The solar load ratio correlations presented in this paper are based on a numerical model developed and validated against test cell data at Los Alamos.

47638 (SAND—83-0137C) **Proceedings of the distributed solar collector summary conference: technology and applications.** Alvis, R.L. (ed.). (Sandia National Labs., Albuquerque, NM (USA)). Mar 1983. Contract AC04-76DP00789. 357p. (CONF-830316—). NTIS, PC A16/MF A01. File Number DE83010276.

From Distributed solar collector conference; Albuquerque, NM, USA (15 Mar 1983).

This report is the Proceedings for a meeting on distributed solar collector system technology held at Albuquerque, NM in March 1983. The meeting covered research on development of components and subsystems, systems engineering and analysis, the results of the Modular Industrial Solar Retrofit (MISR) project, including system design descriptions and test results, and finally, operating experiences and performance data from distributed collector experimental field projects. Papers included in this Proceedings are abstracted individually for EDB.

47639 (SERI/RR—253-1750) **Low-cost collectors/systems development progress report.** Kutscher, C.; Davenport, R.; Farrington, R.; Jorgensen, G.; Lewandowski, A.; Vineyard, C. Jul 1984. Contract AC02-83CH10093. 225p. NTIS, PC A10/MF A01. File Number DE84013032.

This report describes research done in FY 1982 at the Solar Energy Research Institute to lower the installed cost of residential solar space heating and domestic hot water systems. After surveying candidate system designs, the drainback system was chosen for further analysis. Criteria for filling, draining, and establishing a siphon were determined analytically and experimentally. The effects of different heat exchanger locations were investigated using computer simulations, and a method for reducing pumping power was established. Use of polybutylene piping and low cost storage tanks were identified as major contributors to cost reduction. To identify low-cost collector concepts, two detailed materials surveys were conducted - one for absorbers, the other for glazings. The new lightweight laminated polymers were identified as promising glazing materials. It was concluded that the installed cost of a drainback system, using polybutylene piping and currently available low-cost collectors could be brought down to about $270/m^2 ($25/ft^2). Further development of new low-cost collector concepts is needed to bring this price down to $150/m^2 ($14/ft^2), which is the cost required to supply a 5-year discounted payback period vs. electricity (based on national averages and assuming no tax credits).

47640 (SOLAR/1017—80/04) **Facilities development. Monthly performance report, April 1980.** Evans, K.D. (Vitro Labs., Silver Spring, MD (USA)). Apr 1980. Contract AC01-79CS30027. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84017366.

The solar energy system in the Facilities Development apartment building supplied 25% of the hot water required during April. The 31-unit condominium apartment building in San Diego, California, uses solar energy to preheat the domestic hot water. Solar energy is stored in a 1000-gallon tank and water is run on demand to the individual apartment hot water tanks. The solar energy system collected 43% of the incident solar energy, and 88% of the collected energy was delivered to the hot water system. The system provided a total energy savings of 9.67 million Btu. Technical details of the performance of this system are presented. The Energy Flow Diagram summarizes the net energy flows through the system and shows major losses, operating energies, and required auxiliary energy for April.

47641 (SOLAR/2029—80/03) **Troy-Miami Library. Monthly performance report, March 1980.** Howard, B.D. Mar 1980. Contract AC01-79CS30027. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84017362.

The solar energy system at the Troy Miami Library collected 40% of available insolation and supplied 80% of the total space conditioning load in March. Operation of the solar system resulted in the saving of 18.09 million Btu of electrical energy which is a considerable energy savings. The solar system has evacuated tube collectors which supply hot water to a 5000-gallon underground storage tank. Solar heat is supplied to five space heating zones in the 23,000 square foot structure and can be delivered either from storage or directly from the collector array. Auxiliary space heating is supplied by duct, strip and area heaters fitted in the file heating zones. Solar controls permit selection of solar energy prior to selection of electrical heating units. Technical details on the performance of this system are presented. The Energy Flow Diagram summarizes the net energy flows through the system, and shows major losses, operating energies and required auxiliary energy for March.

47642 **Long term stability and performance of solar system instrumentation.** Lior, N.; Brish, R.T.; Koffs, S.; Tedori, L. (Department of Mechanical Engineering and Applied Mechanics, University of Pennsylvania, Philadelphia, Pennsylvania). *American Society of Mechanical Engineers, [Paper]*; **83-WA/SOL-7**: 6(Nov 1983). (CONF-831111—).

From ASME winter annual meeting; Boston, MA, USA (13 Nov 1983).

In an attempt to improve the quality and reliability of methods used for long-term performance evaluation of solar systems, detailed information is provided about the long-term (typically over 2 years) performance and stability of a relatively large number of instruments used in the performance monitoring of a well-instrumented solar heating project. The calibration methods are also described. The instruments include resistance temperature detectors, several types of flowmeters, wattmeters, pyranometers, wind anemometers, a humidity meter, a barometer, differential temperature solar system controllers, and an automatic data acquisition system used to scan, convert and store the data. Recommendations for good instrumentation of solar systems are also provided. It was found that the critical instruments for performance evaluation, and most of the instruments overall, have performed very well over the long term, allowing thermal performance evaluation with an accuracy better than 3% with only one calibration per year.

47643 **The performance of desiccant dehumidifier air-conditioning systems using cooled dehumidifiers.** Schultz, K.J.; Beckman, W.A.; Mitchell, J.W. (Solar Energy Laboratory, University of Wisconsin-Madison, Madison, WI). *American Society of Mechanical Engineers, [Paper]*; **83-WA/SOL-15**: 7(Nov 1983). (CONF-831111—).

From ASME winter annual meeting; Boston, MA, USA (13 Nov 1983).

A generic model of a cooled dehumidifier suitable for use in estimating the seasonal performance of cooled desiccant dehumidifier air-conditioning systems is developed. A system configuration appropriate for using a cooled dehumidifier is presented. Estimates of the seasonal performance of the cooled system are presented and compared with adiabatic dehumidifier system performance. Both gas-fired and solar-assisted operations are considered. It is found that the cooled system can be competitive with the adiabatic ventilation system, particularly in solar-assisted applications if a high level cooled dehumidifier can be developed.

47644 **Assessment of data on hot water use in commercial establishments.** Silver, J.D.; Burrows, D.L. pp 155-158 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

Because of the need to achieve the most efficient utilization of its electric generating capacity, the Tennessee Valley Authority has embarked on several programs related to solar energy, energy conservation, and load management. Included in these programs is the Commercial and Industrial (C&I) Active Solar Systems project. An important part of this project is the determination of energy end use patterns in commercial establishments. From a utility standpoint, the potential for peak power demand reduction is important and is determined by matching these patterns to the utility pattern. The patterns are also of importance to the architectural/engineering community. They reflect the hot water end use patterns which must be considered in the present-day concept of energy-efficient buildings and load-matched (rather than oversized) equipment. During the early phases of the C&I Active Solar Systems project at TVA, a considerable amount of hot water end use data were collected to screen candidate sites. Additional data are now being collected on active solar systems which have been installed. These data are available for several different types of establishments (i.e., restaurants, hotels/motels, apartments, etc.). The data have been compared to the most commonly used documented data previously available, which is contained in the Systems Section of the ASHRAE Handbook. This paper presents the results of these comparisons, some of which represent significant differences from the accepted guidelines. These differences should be of importance to the designers of commercial buildings and mechanical and solar systems for these buildings.

1410 Solar Collectors And Concentrators

47645 **(BNL—51693) Development of low-cost polymer film solar collectors. Annual report.** Andrews, J.W.; Le Doux, P.; Metz, P.D.; Wilhelm, W.G. (Brookhaven National Lab., Upton, NY (USA)). Sep 1983. Contract AC02-76CH00016. 70p. NTIS, PC A04/MF A01; GPO Dep. File Number DE84017196.

This report covers work performed on the Brookhaven National Laboratory polymer film collector project during the period October 1, 1981 to November 1, 1982, in four major areas of endeavor: materials, engineering, economics, and testing. It also describes the search for solutions to the major problem - delamination of the polymer and metal sheets in the absorber - which occurred during the severe conditions associated with solar cooling applications. Finally, it outlines the plan of work for fiscal year 1983.

47646 **(DOE/SF/11937—T1) Innovative receiver design for parabolic trough and paraboloidal dish solar collectors. Final report.** Kuehn, T.H. Sep 1984. Contract AC03-83SF11937. 116p. NTIS, PC A06/MF A01; GPO Dep. File Number DE84016587.

The purpose of this contract is to determine the feasibility of using a receiver with a porous absorber in line- and point-focus solar thermal collector systems. The potential benefits in thermal performance, initial cost, fabrication and reliability are considered as compared with conventional receivers. Major emphasis was placed on the development of a simple thermal model of the line-focus receiver design and conducting parametric studies aimed at optimizing its thermal performance. Candidate fluids and materials were evaluated to select appropriate components using off-the-shelf items. The intention is to minimize initial cost and fabrication difficulties while maintaining a design with superior thermal performance. Less emphasis was placed on the design of the point-focus receiver. However, a survey of the literature on boiling in porous media and possible window materials and configurations was made to provide some preliminary design guidelines. The first section of the report covers the simulation work done on the line-focus receiver. This is followed by the materials selection criteria and the fabrication and cost estimates. The next section summarizes the work conducted on the point-focus receiver design including the boiling literature review and materials selection criteria. Details of the thermal model development, simulation results, and material selection for the line-focus design are given in the Appendices.

47647 **Reflectance of metallic indium for solar energy applications.** Bouquet, F.L.; Hasegawa, T. (Jet Propulsion Laboratory, Applied Mechanics Technology Section, California Institute of Technology, Pasadena, CA). *Solar Energy;* **32**: No. 2, 311-312(1984).

The Solar Thermal Power Systems (TPS) effort at the Jet Propulsion Laboratory (JPL) is sponsored by the U.S. Department of Energy (DOE) for the purpose of developing systems capable of producing competitively-priced thermal and electric energy for utility, industrial and isolated applications. An important phase of this research is design an development of efficient, long-lived reflective surfaces for the solar concentrator. One aspect is the evaluation of alternative types of mirrors and one of these, indium, is reported herein. Because limited quantitative data on the reflective properties of metallic indium over the entire spectrum was available in the open literature, an investigation was initiated. The fabricated samples were of sufficient quality that differences from similar second-surface silvered mirrors were not noticable to the human eye.

47648 **Protection against freezing in solar-energy systems.** Wolosewicz, R.M.; Vresk, J. (Argonne National Laboratory, Argonne, IL). *American Society of Mechanical Engineers,* [*Paper*]; **83-WA/SOL-14**: 8(Nov 1983). (CONF-831111—).

From ASME winter annual meeting; Boston, MA, USA (13 Nov 1983).

Solar-energy systems that are liquid-cooled can freeze if engineering design details have not been properly developed. By means of flow chart, the author presents a composite picture of the problems that have led to freezing some solar-energy systems. Guidelines for avoiding some of these problems are discussed, and recommendations are made for the set points of the freeze-protection thermostat. The author also estimates the probability that freeze-protection systems will fail. Failure analyses of several components from solar-energy systems are presented.

47649 **Determination of error tolerances for optical design of parabolic troughs.** Guven, H.M.; Bannerot, R.B.; Mistree, F. (Mechanical Engineering Department, University of Houston, Houston, Texas). *American Society of Mechanical Engineers,* [*Paper*]; **83-WA/SOL-1**: 11(Nov 1983). (CONF-831111—).

From ASME winter annual meeting; Boston, MA, USA (13 Nov 1983).

A study is presented where potential optical errors in parabolic troughs are divided into two groups: random and non-random. Small-scale slope errors, mirror nonspecularity, apparent changes in sun's width, and small occasional tracking errors are classified as random errors. Reflector profile errors, misalignment of the receiver with the effective focus of the reflector, and misalignment of the trough with the sun are classified as non-random errors. Random errors are analyzed using statistics and assuming a normally distributed error. Non-random errors are analyzed by building provisions into the optical model which allow for the analysis of such errors. Universal design curves showing the effect of random and non-random errors on the optical performance (efficiency) of the trough are presented.

47650 **Dish concentrators for solar thermal energy.** Jaffe, L.D. (Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California). *Journal of Energy;* **7**: No. 4, 304-312(Jul 1983).

A wide variety of point-focusing concentrators are under consideration for solar thermal energy use. They are briefly reviewed in this paper. These concentrators differ in such characteristics as optical configuration and materials, structure for support of the optical elements and receiver, mount, foundation, drive, and controls. Point-focusing concentrators require good optical efficiency and, especially for high-temperature applications, high geometric concentration ratios. Most important are low cost, as installed, and low lifetime cost. Critical cost contributors for quantity production are the cost of materials and the cost of installation labor. Field testing and performance measurements of concentrators, with receivers and controls, are badly needed.

47651 **Operational experience with flat-plate photovoltaic systems.** Risser, V.V.; Dorand, S.; Hutchinson, P. (New Mexico Solar Energy Institute, Las Cruces, New Mexico). *Journal of Energy;* **7**: No. 4, 332-337(Jul 1983).

In 1977-78 the U.S. Department of Energy initiated a program to obtaine experience in the operation and maintenance of intermediate-sized photovoltaic systems. After evaluation to competitive proposals, four flatplate and five concentrator-type photovoltaic systems were selected for construction. This paper describes the first-year operational results of two of the flat-plate systems, both located in the semiarid climate of the southwestern United States. The 20 kW system in El Paso, Texas, has been operating since January 1981. The 100 kW system in Lovington, N. Mex., has been operating since March 1981. A complete project record is maintained by using an extensive instrumentation system that records performance data and weather information at each site. This information is augmented by recording all required maintenance activity on the system. The New Mexico Solar Energy Institute is monitoring performance and assisting with maintenance on both systems. Performance to date is encouraging for those interested in this alternate energy technology. It clearly shows that successful operation of large-scale flat-plate systems is achievable today.

1420 Heat Storage

REFER ALSO TO CITATION(S) 14200047609

15 GEOTHERMAL ENERGY

47652 (CONF-8310177—) **Proceedings of the Geothermal Program Review II.** Dec 1983. 447p. NTIS, PC A19/MF A01; 1; GPO Dep. File Number DE84005062.

From 2. annual DOE geothermal progress review meeting; Washington, DC, USA (11 Oct 1983).

Separate abstracts were prepared for individual papers. (MHR)

47653 (CONF-8310177—, pp 289-300) **Technology transfer of geopressured/geothermal resources to industry.** Dorfman, M.H.; Morton, R.A. (Univ. of Texas, Austin). Dec 1983. NTIS, PC A19/MF A01. File Number TI84005062.

From 2. annual DOE geothermal progress review meeting; Washington, DC, USA (11 Oct 1983).

This research, conducted by the Bureau of Economic Geology and the Center for Energy Studies, includes the following areas of interest; geological studies depicting pressure gradients and thermal gradients, sand distribution and fault patterns, all of which are used in petroleum exploration; geophysical data for interpretation of seismic velocities based upon lithologic changes and subsurface discontinuities; sandstone consolidation data involving changes of permeabilities with depth and diagenetic histories of Cenozoic rocks in the Gulf Coast Basin - this work also covers fluid migration pathways and resulting rock-water interactions and has led to a better understanding of generation, maturation and accumulation of hydrocarbons; work on salinity of formation waters covering several areas of study, such as chemical analysis to anticipate scale and corrosion problems, and investigations of logging techniques to better ascertain salinity of use of well logs; reservoir continuity studies, together with computational modelling to assist in estimation of ultimate recoveries and formation drives; rock mechanics studies, which have recently led to the development of new models to account for creep and determine compressibilities of sandstones and shales in geopressured environments; co-production of gas and water in watered-out gas reservoirs.

1501 Resource Status And Assessment

REFER ALSO TO CITATION(S) 15010047366, 47368, 47420, 47703, 47705, 47706, 47707, 47708

47654 (DOE/ET/27103—T1) **Support services relating to geothermal programs. Final report.** (Terra Tek, Inc., Salt Lake City, UT (USA)). Aug 1981. Contract AC01-79ET27103. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84016129.

Activities designed to assist in the assessment of processes through which geopressured methane production and geopressure-geothermal power can be increased are discussed. Progress is reported on the following: general support, hot-dry-rock review, R and D plan, and the Edna Delcambre final report. (MHR)

47655 (DOE/IA—0009-2-Vol.2, pp 69-78) **Geothermal energy.** Fournier, R.O. Aug 1979. NTIS, PC A08/MF A01. File Number TI84011695.

In Joint Peru/United States report on Peru/United States cooperative energy assessment. Volume 2. Annex 1.

The geothermal resource potential of Peru is described as follows: estimated geothermal resources at temperatures greater than 180°C, estimated geothermal resources at temperatures less than 180°C, potential installed capacity in 1985 and 2000, investment required, and labor requirements. (MHR)

47656 (DOE/IA/06316—T2, pp E1-E28) **Assessment of geothermal resources in the Republic of Korea.** Banks, N.G. Sep 1981. NTIS, PC A12/MF A01. File Number TI84011647.

In Republic of Korea/United States cooperative energy assessment. Volume III. Reference reports. Part 1 of 3 parts.

Mainland - Usable geothermal energy on mainland Republic of Korea (ROK) appears to be confined to low-enthalpy (low-temperature) and perhaps intermediate-enthalpy waters at 20 known localities and at other localities with similar structural and hydrologic conditions that may be discovered by additional geologic, geochemical, and geophysical studies. The outlook for the discovery of high-enthalpy fluids and high-temperature reservoir rocks at currently exploitable depths is not promising. Cheju-do - There is some potential for high- or intermediate-enthalpy geothermal systems on the volcanic islands of Cheju-do and Ulleung-do. The islands are Quaternary alkalic volcanoes, and there have been four recorded eruptions on the island of Cheju-do within the last 1000 years. Therefore, there is potential for past or future hot-rock systems at shallow depth that, given favorable hydrologic conditions, could be exploited for geothermal power (150° to 250°C) or for product processing (90° to 150°C). It is emphasized, however, that presence of potential does not necessarily indicate presence of a geothermal system. Furthermore, the geothermal potential of alkalic volcanoes does not closely approach that of active silicic volcanoes or even that of active tholeiitic basalt volcanoes (such as Kilauea Volcano, Hawaii) that have proven shallow storage reservoirs of magma. 26 references.

47657 (DOE/IA/06316—T3, pp C.1-C.63) **Geothermal resources in Portugal and the Azores.** Johnston, D.A. Sep 1981. NTIS, PC A07/MF A01. File Number TI84011696.

In Portugal/United States Cooperative Energy Assessment. Volume III. Reference reports, part 1 of 3 parts.

The potential for geothermal energy in mainland Portugal is confined to direct use of low-enthalpy (that is, low-temperature) fluids. Chemical geothermometry of thermal spring waters indicates that most reservoir temperatures are less than 100°C. The highest estimated reservoir temperatures (144° average) for thermal waters emitted at Chaves are unreliable because of the exceptionally high CO_2-content of the waters. Thermal springs are located in northern Portugal, in the western coastal plain, and in southwestern Portugal. Those in the north are primarily along major faults, which, along with the springs themselves, are primary exploration targets. Thermal waters are apparently produced by deep circulation along these faults, particularly in areas of granitic basement. In western and southwestern Portugal, springs may be emitted along minor faults or fractures. The springs in northern Portugal are hottest and come from reservoirs having the highest calculated reservoir temperatures.

47658 (EPRI-AP—3271, pp 3.50-3.54) **Initial exploration results: COSO Geothermal Field Inyo County, California.** Moore, J.L.; Austin, C. (California Energy Company, Inc., Santa Rosa). Sep 1983. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920082. (CONF-8306177—).

From 7. annual geothermal conference and workshop; San Diego, CA, USA (28 Jun 1983).

The Coso geothermal area in Inyo County, California is described. Extensive geological, geophysical, and geochemical studies of the area have been conducted making it one of the most thoroughly studied geothermal prospects in the US. The Coso geothermal system, its reservoir rocks and fractures, magmatic heat source, groundwater flow patterns, caprock or seals, and the Coso Navy Exploratory Well 75-7 are described.

47659 (EPRI-AP—3271, pp 3.55-3.62) **Lakeview, Oregon, geothermal development case history.** Brown, D.E.; Meyer, H.J.; Wood, J.S. (Oregon Department of Energy, Salem). Sep 1983. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920082. (CONF-8306177—).

From 7. annual geothermal conference and workshop; San Diego, CA, USA (28 Jun 1983).

The development of the geothermal resources of the hot springs near Lakeview, Oregon is discussed. Lakeview is located near the north end of the Goose Lake Valley in south-central Oregon about 335 air miles from Portland. The geology and water chemistry of the area are described. The geothermal exploration history as recent exploration activities are discussed. A low-temperature binary power plant was installed in March, 1982. The operation and performance of the 40 kW plant are discussed. The project is being monitored by the Oregon Department of Energy.

47660 (EPRI-AP—3271, pp 7.1-7.2) **High-temperature geothermal resources in hydrothermal convection systems in the US.** Nathenson, M. (Geological Survey, Menlo Park, CA). Sep 1983. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920082. (CONF-8306177—).

From 7. annual geothermal conference and workshop; San Diego, CA, USA (28 Jun 1983).

The calculation of high-temperature geothermal resources (>150°C) in the US has been done by estimating the temperature, area, and thickness of each identified system. These data, along with a general model for recoverability of geothermal energy and a calculation that takes account of the conversion of thermal energy to electricity, yielded an estimate of 23,000 MW/sub e/ for 30 years. The undiscovered component was estimated based on multipliers of the identified resource as either 72,000 or 127,000 MW/sub e/ for 30 years depending on the model chosen for the distribution of undiscovered energy as a function of temperature.

47661 (EPRI-AP—3271, pp 7.28-7.29) **Steam producers perspective.** Greider, B. (Geothermal Resources International, Inc., Menlo Park, CA). Sep 1983. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920082. (CONF-8306177—).

From 7. annual geothermal conference and workshop; San Diego, CA, USA (28 Jun 1983).

It is believed that future geothermal resource development will be concentrted in areas that have the following attributes: (1) utilities in the business or have a genuine interest in using geothermal plants for new capacity, (2) electric power networks in place and functioning, (3) financial community familiar with and willing to support plant construction and energy supply systems, and (4) governmental regulatory agencies familiar with geothermal systems and their benefit to the community. It is concluded that the most important stimulant to increase the utilization of geothermal energy is the understanding that a geothermal prospect worth development is one that will provide a useful product at less total cost than any other available and reliable source of energy.

47662 (EPRI-AP—3271, pp 5.68-5.74) **Geopressure revisited, 1983.** Swanson, R.K.; Osoba, J.S.; Bernard, W.J. (Southwest Research Inst., San Antonio, TX). Sep 1983. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920082. (CONF-8306177—).

From 7. annual geothermal conference and workshop; San Diego, CA, USA (28 Jun 1983).

During the past several years considerable interest has centered on deep tertiary sediments called geopressured zones, in an area encompassing about 100,000 mi^2 along the Texas/Louisiana Coast. These sediments are characterized by high pressures, and exhibit moderately elevated temperatures. Research directed toward the evaluation of these deposits over the past several years has recently culminated in a series of test wells, the results of which can now be analyzed and applied to further understanding the usefulness of this resource. The Gulf Coast geopressured zones are described along with the reservoir characteristics and the test well program.

47663 (EPRI-AP—3271, pp 3.18-3.26) **Meager Creek Geothermal Project: preliminary resource evaluation.** Stauder, J.J.; Menzies, A.J.; Harvey, C.C.; Leach, T.M. (British Columbia Hydro, Vancouver). Sep 1983. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920082. (CONF-8306177—).

From 7. annual geothermal conference and workshop; San Diego, CA, USA (28 Jun 1983).

A 190-200°C geothermal resource has been identified in the Meager Creek Geothermal Area (South Meager, previously called the South Reservoir), British Columbia, Canada, on the basis of surface and near surface exploration and the results of a three well deep drilling exploration program. The geothermal resource appears to be fracture dominated with limited flow capacity. It is associated with the Meager Creek Fault Zone which was encountered by the deep wells at a depth of 1200-1600 meters (400-800 meters below MSL). Temperatures of up to 270°C were encountered below the Meager Creek Fault Zone but both petrologic and well testing data indicate that the rock is generally impermeable. The high temperatures at depth appear to be a manifestation of the abnormally high (approximately equal to 90°C/km) regional geothermal gradient.

47664 (EPRI-AP—3271, pp 3.27-3.45) **Integrated geoscientific exploration at Meager Creek British Columbia (1982).** Harvey, C.C.; Leach, T.M.; Macdonald, W.J.P. (KRTA Ltd., Auckland, New Zealand). Sep 1983. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920082. (CONF-8306177—).

From 7. annual geothermal conference and workshop; San Diego, CA, USA (28 Jun 1983).

The application of an integrated geoscientific approach to the exploration stage of the Meager Creek geothermal project in British Columbia is discussed. The approach has provided a preliminary assessment of the resource potential of the area. The work has included geological reconnaissance, geophysics, and an extensive geochemical sampling program. The surveys have indicated that a geothermal resource exists on the south side of the Meager Complex an outflows down the Meager Valley. Geophysical surveys and drilling operations failed to identify evidence of an outflow from an active high-temperature geothermal system on the north side of the Meager complex.

47665 **(N—84-23988) Geothermal resources of southern Idaho.** Mabey, D.R. (Geological Survey, Washington, DC (USA)). 1983. 28p. (USGS-CIRC—866). NTIS, PC A03/MF A01.

The geothermal resource of southern Idaho as assessed by the U.S. Geological Survey in 1978 is large. Most of the known hydrothermal systems in southern Idaho have calculated reservoir temperatures of less than 150 C. Water from many of these systems is valuable for direct heat applications. A majority of the known and inferred geothermal resources of southern Idaho underlie the Snake River Plain. However, major uncertainties exist concerning the geology and temperatures beneath the plain. The largest hydrothermal system in Idaho is in the Bruneau-Grang View area of the western Snake River Plain with a calculated reservoir temperature of 107 C and an energy of 4.5 x 10 to the 20th power joules. No evidence of higher temperature water associated with this system was found. Although the geology of the eastern Snake River Plain suggests that a large thermal anomaly may underlie this area of the plain, direct evidence of high temperatures was not found. Large volumes of water at temperatures between 90 and 150 C probably exist along the margins of the Snake River Plain and in local areas north and south of the plain.

1502 Geology And Hydrology Of Geothermal Systems

REFER ALSO TO CITATION(S) 15020047657, 47670

47666 **(AD-A—141763/3) Geothermal potential of Ascension Island, South Atlantic. Preliminary report.** Neilson, D.L.; Sibbett, B.S. 5 Nov 1982. 87p. NTIS, PC A05/MF A01.

Ascension Island is a geologic anomaly. It was formed by volcanism along the Mid-Atlantic Ridge about 7 million years ago, and that volcanism has continued as the oceanic plate moved westward away from the media valley of the ridge. Geologic mapping during this study has documented the distribution and age relationships of lithologies and structures. Chemical analysis of rocks samples and have allowed a quantitative classification of rock types. Potential for a geothermal discovery on Ascension Island is very high.

47667 (CONF-8310177—, pp 321-325) **Geologic and hydrologic research on the Moana geothermal system, Washoe County, Nevada.** Flynn, T.; Ghusn, G. Jr. (Univ. of Nevada, Las Vegas, Reno). Dec 1983. NTIS, PC A19/MF A01. File Number TI84005062. Contract FC03-80RA50075.

From 2. annual DOE geothermal progress review meeting; Washington, DC, USA (11 Oct 1983).

The Moana geothermal area is the largest single low- to moderate-temperature geothermal resource in the State of Nevada presently employed for direct-use applications. Approximately 150 individual wells, representing a total estimated investment of $5 to $7 million, are presently used to provide heat ahd hot water to more than 130 private residences, several churches and two large motels. Although most of the wells are constructed to meet the heating needs of individual homes, a large-scale district space heating system, designed to supply heat to 60 houses from a single well, is now being developed. Usable temperatures range from 50 to 99°C (120 to 210°F); well depths range from 60 to 400 m (100 to 1300 ft). The number of new wells coming on-line in Moana is two to three per month. Development of the resource has been largely unregulated and questions dealing with reported reservoir temperature and water level declines, loss of artesian flow, and fluid disposal have recently surfaced. In October 1982, a geologic and hydrologic research program began that was designed to provide detailed geothermal reservoir data to present or prospective developers. The program combines geophysical, geochemical, and geological surveys of the Moana resource area with a drilling program for 5 monitor/observation wells. Data from this program are supplied directly to developers as well as state and local government agencies to provide for prudent resource development. This paper summarizes the program elements and describes the present status.

47668 (CONF-8310177—, pp 326-331) **Volcanic rock petrochemistry as an exploration technique for geothermal energy.** Fultz, L.A.; Bell, E.J.; Trexler, D.T. (Univ. of Nevada, Las Vegas, Reno). Dec 1983. NTIS, PC A19/MF A01. File Number TI84005062.

From 2. annual DOE geothermal progress review meeting; Washington, DC, USA (11 Oct 1983).

Large high-level silicic magma chambers offer a high potential for economically viable geothermal systems. While purely basic volcanic systems rarely form thermal anomalies, they may provide the necessary long-term heat input to silicic systems, by underplating, to sustain a high-temperature geothermal system. Petrographic and microprobe, geochemical, geochronologic, and isotopic data on young volcanic rocks in west-central Nevada indicate compositions that may result from magmatic differentiation, crystal fractionation, variation in magmatic source regions and in particular, magma mixing. Analysis of the petrochemistry and the recognition of magma mixing textures of extrusive rocks may indicate interacting mafic magma with buried shallow silicic magma systems. These systems may provide a shallow heat source for development of geothermal resources.

47669 **Transport and diffusion in the transition layer and planetary boundary layer for drainage flows in Anderson and Putah Creeks, California, during ASCOT 1980.** Fosberg, M.A. (Forest Service Pacific Southwest Forest and Range Experiment Station, U.S. Department of Agriculture, Riverside, CA 92507). *Journal of Applied Meteorology;* **23**: No. 5, 812-823(May 1984).

Approximately 100 constant-volume, superpressured balloons (tetroons) were tracked in the Anderson and Putah Creek drainages of the Geysers geothermal area of northern California as part of the ASCOT (Atmospheric Studies in Complex Terrain) program. These tetroons were tracked by radar. Each tetroon was equipped with a transponder which provided a 100 MHz shift in frequency, providing a means of discriminating the tetroon-transponder broadcast signal from radar signals reflected from the hard terrain.

1503 Geothermal Exploration And Exploration Technology

REFER ALSO TO CITATION(S) 15030047662, 47667, 47668, 47717, 47719

47670 (CONF-8310177—, pp 242-265) **Cerro Prieto geothermal field, Mexico. The experiences gained from its exploration and development.** Lippmann, M.J.; Goldstein, N.E.; Halfman, S.E.; Witherspoon, P.A. (Univ. of California, Berkeley). Dec 1983. NTIS, PC A19/MF A01. File Number TI84005062.

From 2. annual DOE geothermal progress review meeting; Washington, DC, USA (11 Oct 1983).

47671 (CONF-8310177—, pp 317-320) **Geothermal research in Nevada.** Trexler, D.T.; Flynn, T. (Univ. of Nevada, Las Vegas). Dec 1983. NTIS, PC A19/MF A01. File Number TI84005062.

From 2. annual DOE geothermal progress review meeting; Washington, DC, USA (11 Oct 1983).

47672 **(DOE/SF/10855—T2) Resource investigation of low- and moderate-temperature geothermal areas in Paso Robles, California.** Campion, L.F.; Chapman, R.H.; Chase, G.W.; Youngs, L.G. (California State Dept. of Conservation, Sacramento (USA). Div. of Mines and Geology). 1983. Contract FG03-80SF10855. 175p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE84016519.

Ninety-eight geothermal wells and springs were identified and plotted, and a geologic map and cross sections were compiled. Detailed geophysical, geochemical, and geological surveys were conducted. The geological and geophysical work delineated the basement highs and trough-like depressions that can exercise control on the occurrence of the thermal waters. The Rinconada fault was also evident. Cross sections drawn from oil well logs show the sediments conforming against these basement highs and filling the depressions. It is along the locations where the sediments meet the basement highs that three natural warm springs in the area occur. Deep circulation of meteoric waters along faults seems to be a reasonable source for the warm water. The Santa Margarita, Pancho Rico, and Paso Robles Formations would be the first permeable zones that abut the faults through which water would enter. Temperatures and interpretation of well logs indicate the warmest aquifer at the base of the Paso Robles Formation. Warm water may be entering higher up in the section, but mixing with water from cooler zones seems to be evident. Geothermometry indicates reservoir temperatures could be as high as 91°C (196°F).

1504 Legal And Institutional Aspects

REFER ALSO TO CITATION(S) 15040047704

1505 Economic And Financial Aspects

REFER ALSO TO CITATION(S) 15050047702

47673 (EPRI-AP—3271, pp 7.30-7.35) **DOE outlook.** Mock, J.E.; Toms, R.S.H. (Department of Energy, Washington, DC). Sep 1983. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920082. (CONF-8306177—).

From 7. annual geothermal conference and workshop; San Diego, CA, USA (28 Jun 1983).

Recent accomplishments and current planning in the DOE geothermal program are discussed. Some changes in emphasis and program focus, as the technology base for the hydrothermal program reaches maturity, will also be discussed.

1506 Environmental Aspects And Waste Disposal

47674 (CONF-8310177—, pp 288) **Land subsidence and microseismicity associated with geopressured-geothermal fluid production.** Groat, C.G. (Louisiana Geological Survey, Baton Rouge). Dec 1983. NTIS, PC A19/MF A01. File Number TI84005062.

From 2. annual DOE geothermal progress review meeting; Washington, DC, USA (11 Oct 1983).

47675 (CONF-8310177—, pp 383-399) **Injection overview.** Prestwich, S. (Dept. of Energy, Idaho Falls, ID). Dec 1983. NTIS, PC A19/MF A01. File Number TI84005062.

From 2. annual DOE geothermal progress review meeting; Washington, DC, USA (11 Oct 1983).

The test program was initiated at the Raft River Geothermal Field in southern Idaho in September 1982. A series of eight short-term injection and backflow tests, followed by a long-term injection test, were conducted on one well in the field. Tracers were added during injection and monitored during backflow as well. The principal objective was to determine if tracers could be effectively used as a means to assess reservoir characteristics in a one-well test. The test program resulted in a unique data set which shows promise as a means to improve understanding of the reservoir characteristics. In December 1982, an RFP was issued to obtain an industrial partner to obtain follow-on data on the injection/backflow technique in a second field, and to study any alternate advanced concepts for injection testing which the industrial community might recommend. The East Mesa Geothermal Field was selected for the second test series. Two wells were utilized for testing, and a series of ten tests were conducted in July and August 1983, aimed principally at further evaluation of the injection/backflow technique.

47676 (CONF-8310177—, pp 400-415) **Disposal of flashed brine dosed with $CaCo_3$ scale inhibitor: what happens when the inhibitor is exhausted.** Michels, D.E. (Republic Geothermal Inc., Santa Fe Springs, CA). Dec 1983. NTIS, PC A19/MF A01. File Number TI84005062.

From 2. annual DOE geothermal progress review meeting; Washington, DC, USA (11 Oct 1983).

Inhibited, flashed brine is thermodynamically poised to deposit $CaCo_3$. Eventually the scale inhibitor will be overcome by dilution in native reservoir fluid, sorption on rocks, slow overgrowth of $CaCO_3$, decomposition, or some combination of processes. Consequences to the reservoir which receives the fluid apparently have not been previously explored. However, Huff-Puff tests (monitored backflow of injected tracers), carried out at East Mesa in the summer of 1983, have provided a starting point for addressing the questions. An effective lifetime of about 14 hours is indicated for one inhibitor. Additionally, reactions between injected fluid and native resource fluid have been observed in two contexts: (1) The native fluid around the disposal well is the unflashed counterpart of the injectate; (2) the native fluid around the disposal well is chemically distinct from the injectate and from its unflashed counterpart. In the two cases investigated, situation (1) yielded significant reaction (deposition of $CaCO_3$) whereas, situation (2) appeared unreactive. These outcomes have important implications regarding the mechanics of reservoir management for long-term electricity production.

47677 **(PB—84-199926) Compendium of selected methods for sampling and analysis at geothermal facilities. Summary report.** Kindle, C.H.; Pool, K.H.; Ludwick, J.D.; Robertson, D.E. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1984. 184p. (EPA/600/4—84-049). NTIS, PC A09/MF A01.

The establishment of generally accepted methods for characterizing geothermal emissions has been hampered by the independent natures of both geothermal industrial development and sampling/analysis procedures despite three workshops on the latter (Las Vegas 1975, 1977, 1980). An independent study of the field has resulted in a compilation of the best methods for sampling, preservation and analysis of potential pollutants from geothermally fueled electric power plants. These methods have been selected as the most usable over the range of application commonly experienced in the various geothermal plant sample locations. In addition to plant and well piping, techniques for sampling cooling towers, ambient gases, solids, surface and subsurface waters are described. Emphasis is placed on the use of sampling probes to extract samples from heterogeneous flows. Where possible, analytical methods capable of reaching 'aquatic life criteria' sensitivities are described. This series of techniques is best if applied, or directly monitored, by one person to optimize consistent use and interpretation. Certain sampling points, constituents and phases of plant operation are more amenable to quality assurance improvement in the emission measurements than others and are so identified.

1508 Geothermal Power Plants

REFER ALSO TO CITATION(S) 15080047659, 47661, 47673, 47677

47678 (CONF-8310177—, pp 58-75) **Review of the 500 kw direct contact geothermal plant at East Mesa.** Nichols, K.E. (Barber-Nichols Engineering Co., Arvada, CO). Dec 1983. NTIS, PC A19/MF A01. File Number TI84005062.

From 2. annual DOE geothermal progress review meeting; Washington, DC, USA (11 Oct 1983).

The direct contact heat exchanger, the working fluid recovery evaluation, control of noncondensible gases, and overall plant performance are discussed. (MHR)

47679 (CONF-8310177—, pp 76-116) **Status report on PNL programs on in-line chemical and corrosion instrumentation and geothermal chemistry.** Shannon, D.W. (Pacific Northwest Lab., Richland, WA). Dec 1983. NTIS, PC A19/MF A01. File Number TI84005062.

From 2. annual DOE geothermal progress review meeting; Washington, DC, USA (11 Oct 1983).

The monitoring instruments developed and tested with this program include: corrosion rate meters for brine, isobutane and cooling water; electrodeless conductivity to monitor brine quality and detect gases; redox meter to detect air intrusions; pH meter to monitor acidity which is related to both corrosion and scaling; suspended particle meter to monitor solids that could plug injection wells; CO_2 sensor for brine; and leak detectors for the Heber plant. Plans for FY 84 and the instruments still funded are discussed.

47680 (CONF-8310177—, pp 126-159) **Heat cycle research multi-year program.** Whitbeck, J. (Idaho National Engineering Lab., Idaho Falls). Dec 1983. NTIS, PC A19/MF A01. File Number TI84005062.

From 2. annual DOE geothermal progress review meeting; Washington, DC, USA (11 Oct 1983).

The binary Heat Cycle Research Program is described briefly. The budet and schedule and technical program details are presented. (MHR)

47681 (CONF-8310177—, pp 203-211) **Geoproducts hybrid geothermal/wood fired power plant.** Lawford, T. (Idaho National Engineering Lab., Idaho Falls). Dec 1983. NTIS, PC A19/MF A01. File Number TI84005062.

From 2. annual DOE geothermal progress review meeting; Washington, DC, USA (11 Oct 1983).

This presentation describes the 15 MW(e) hybrid combined cycle power plant being constructed at Honey Lake, near Susanville, California. The power plant will use a wood fired system topping cycle, an organic Ranking (binary) bottoming cycle, and geothermal heating of combustion air and organic working fluid. In addition to a technical description, project economics, project merits, and project status are presented.

47682 (CONF-8310177—, pp 235-241) **Heber Geothermal Binary Demonstration Project.** Allen, R.F.; Nelson, T.T. (San Diego Gas and Electric Co., CA). Dec 1983. NTIS, PC A19/MF A01. File Number TI84005062.

From 2. annual DOE geothermal progress review meeting; Washington, DC, USA (11 Oct 1983).

The project background and objectives are discussed. The following are described: the power cycle, design progress, turbine generators; heat exchangers and condensers, materials selection, heat sales contract, and construction. (MHR)

47683 (CONF-8310177—, pp 309-316) **Combustion-geothermal hybrid power plant for a geopressured well.** Hughes, E.E. (Elecgtric Power Research Inst., Palo Alto, CA). Dec 1983. NTIS, PC A19/MF A01. File Number TI84005062.

From 2. annual DOE geothermal progress review meeting; Washington, DC, USA (11 Oct 1983).

47684 (EGG-M—03484) **Boiler performance and liquid entrainment in a pilot geothermal power plant.** Bliem, C.J. Jr. (EG and G Idaho, Inc., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 14p. (CONF-840816—18). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84017225.

From 22. national heat transfer conference; Niagara Falls, NY, USA (5 Aug 1984).

Two kettle boilers used in a pilot scale version of a binary geothermal power plant were tested over the life of the project. The results of that testing are presented here. In addition to the overall performance of the boilers, the problem of excessive liquid being entrained in the outlet flow was investigated. Although predictions during the design phase indicated that there would be no significant amount of liquid in the outlet vapor flow, large amounts of liquid were detected when the boiler was operated at design liquid level. Tests indicated that the amount of entrainment decreased as the apparent liquid level was decreased. The results of this testing were correlated with boiler level, boiler geometry, fluid properties and vapor velocity. The results of this correlation indicate that there is a threshold below which the entrainment is insignificant, but above that point it increases rapidly. The boilers could be operated at apparent liquid levels lower than the bundle diameter without actually uncovering tubes and thereby eliminate the entrainment. (Instrumented tubes indicated no evidence of the tubes being uncovered until the apparent level was reduced to 60 percent of the bundle diameter.)

47685 (EGG-M—24083) **Effects of vaporizer and evaporative condenser pinch points on geofluid effectiveness and cost of electricity for geothermal binary power plants.** Demuth, O.J. (EG and G Idaho, Inc., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 6p. (CONF-840804—50). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84017224.

From Intersociety energy conversion engineering conference; San Francisco, CA, USA (19 Aug 1984).

A brief study was conducted in support of the DOE/DGHT Heat Cycle Research Program to investigate the influences of minimum approach temperature differences occurring in supercritical-heater/vaporizer and evaporative-condenser heat rejection systems on geothermal-electric binary power plant performance and cost of electricity. For the systems investigated optimum pinch points for minimizing cost of electricity were estimated to range from 5 to 7°F (3 to 4°C) for the heater vaporizer. The minimum approach of condensing temperature to wet-bulb temperature for evaporative condensers was estimated to be about 15°F (8°C) in order to achieve the highest plant net geofluid effectiveness, and approximately 30°F (17°C) to attain the minimum cost of electricity.

47686 (EPRI-AP—3271, pp 4.1-4.2) **Overview of geothermal power systems program.** Roberts, V.W. (Electric Power Research Inst., Palo Alto, CA). Sep 1983. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920082. (CONF-8306177—).

From 7. annual geothermal conference and workshop; San Diego, CA, USA (28 Jun 1983).

Since 1975 EPRI's Geothermal Program has emphasized research that would aid in the development of hydrothermal resources. The EPRI research program has concentrated on binary cycle development, wellhead systems development, subsystems development, studies of the chemistry of geothermal fluids, and advanced geothermal systems.

47687 (EPRI-AP—3271, pp 6.30-6.41) **National outlook in Japan for geothermal energy development.** Kaneko, M. (Ministry of International Trade and Industry, Tokyo, Japan). Sep 1983. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920082. (CONF-8306177—).

From 7. annual geothermal conference and workshop; San Diego, CA, USA (28 Jun 1983).

The importance of geothermal energy development, status of geothermal power generation, economic feasibility of geothermal power generation and government policies for promoting geothermal energy development in Japan are discussed.

47688 (EPRI-AP—3271, pp 6.42-6.51) **Operating experience of double-flash geothermal power plant (Hatchobaru).** Yoshida, K.; Tanaka, K.; Kusunoki, K. (Kyushu Electric Power Company, Inc., Fukuoka, Japan). Sep 1983. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920082. (CONF-8306177—).

From 7. annual geothermal conference and workshop; San Diego, CA, USA (28 Jun 1983).

Hatchobaru No. 1 Unit (55 MW) was completed in 1977 as the world's first double-flash type geothermal power plant and has been operating satisfactorily since that time. The operating record of the Hatchobaru Power Plant and group of wells, including recent findings are described.

47689 (EPRI-AP—3271, pp 6.52-6.58) **Geothermal power development in the Philippines: an update of progress at Tongonan and Palinpinon (Okoy).** Firth, N.W.; Elizagaque, R.F. (KRTA Ltd., Auckland, New Zealand). Sep 1983. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920082. (CONF-8306177—).

From 7. annual geothermal conference and workshop; San Diego, CA, USA (28 Jun 1983).

Development of the geothermal fields at Tongonan (Leyte) and Okoy (Negros) is being carried out by the Ministry of Energy of the Philippines Government. A number of papers have been published previously on a variety of aspects of the work being done at Tongonan and Palinpinon. An update of progress at a time when both projects are well advanced and have commenced, or are about to commence, commercial operation is presented. The setting within which the projects are being developed is first described, and this is followed by a brief discussion of issues of interest which have arisen as development has progressed.

47690 (EPRI-AP—3271, pp 4.11-4.13) **Research and development projects: June 1983.** Sep 1983. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920082. (CONF-8306177—).

From 7. annual geothermal conference and workshop; San Diego, CA, USA (28 Jun 1983).

Short descriptions of the EPRI research and development projects in geothermal power are presented. Twenty-six research and development projects are listed.

47691 (EPRI-AP—3271, pp 6.1-6.16) **Worldwide geothermal power development: an overview and update.** DiPippo, R. (Southeastern Massachusetts Univ., North Dartmouth). Sep 1983. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920082. (CONF-8306177—).

From 7. annual geothermal conference and workshop; San Diego, CA, USA (28 Jun 1983).

During the past year, geothermal power generating capacity has increased by 616.4 MW or 24%. The bulk of this growth has come from new units in the US and the Philippines. The status of geothermal development is discussed and a look at some of the trends that may be emerging for the future is presented.

47692 (EPRI-AP—3271, pp 6.17-6.29) **Status of geothermal electrical power development in Mexico.** Alonso E.H.; Manon M.A. (Comision Federal de Electricidad, Calexico, CA). Sep 1983. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920082. (CONF-8306177—).

From 7. annual geothermal conference and workshop; San Diego, CA, USA (28 Jun 1983).

A review of geothermal power generation in Mexico is given. The status of power plants on-line and under construction at Cerro Prieto, Los Azufres, and Los Humeros is presented. A forecast of generating capacity for the future is given along with the obstacles to geothermal energy development in Mexico.

47693 (EPRI-AP—3271, pp 6.24-6.29) **Geothermal development in Cerro Prieto Baja California, Mexico (1983).** Manon M.A. (Comision Federal de Electricidad, Calexico, CA). Sep 1983. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920082. (CONF-8306177—).

From 7. annual geothermal conference and workshop; San Diego, CA, USA (28 Jun 1983).

The actual stage of the expansion program and some of the main characteristics of the Cerro Prieto Geothermal Field are presented. This is similar to the one presented in this same conference back in 1981, but it has been updated.

47694 (EPRI-AP—3271, pp 2.1-2.4) **Heber Binary Project: binary cycle geothermal demonstration power plant (RP1900-1).** Lacy, R.G.; Nelson, T.T. (San Diego Gas and Electric Co., CA). Sep 1983. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920082. (CONF-8306177—).

From 7. annual geothermal conference and workshop; San Diego, CA, USA (28 Jun 1983).

The objectives of the Heber Binary Project are to demonstrate the potential of moderate temperature (below 410°F) geothermal energy to produce economic electric power with binary cycle conversion technology, and to establish schedule, cost and equipment performance, reservoir performance, and the environmental acceptability of such plants. The plant will be the first large-scale power generating facility in the US utilizing the binary conversion process. The power cycle, design progress, turbine generator, heat exchangers and condensers, materials selection, heat sales contract, and construction schedule are discussed.

47695 (EPRI-AP—3271, pp 2.5-2.12) **Initial operating results 10 MW Salton Sea Geothermal Pilot Plant.** Moss, E. (Southern California Edison Co., Rosemead). Sep 1983. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920082. (CONF-8306177—).

From 7. annual geothermal conference and workshop; San Diego, CA, USA (28 Jun 1983).

The initial operating results of the 10 MW Salton Sea Geothermal Pilot Plant are discussed. The plant has been on line 84% of the time since initial startup in July of 1982. During this time, the plant has been able to provide essentially full load steam making it possible to achieve a capacity factor of over 80%. The forced and scheduled outages of the plant for the first 9 months operation are listed. During this initial operation, over 50 million kWhs of energy have been delivered to the Imperial Irrigation District. The operating costs for operations and maintenance have been running at a rate of $1 M/year.

47696 (EPRI-AP—3271, pp 2.13-2.19) **Geothermal development activities: Roosevelt Hot Springs, Utah.** Brown, D.R. (Utah Power and Light Co., Salt Lake City). Sep 1983. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920082. (CONF-8306177—).

From 7. annual geothermal conference and workshop; San Diego, CA, USA (28 Jun 1983).

Utah Power and Light Company's geothermal development activities at Roosevelt Hot Springs near Milford, Utah are discussed. The company is proceeding with the design and the construction of a 20 MW geothermal generating unit called Milford No. 1. The plant will utilize a hydrothermal reservoir about 2000 ft from the surface with a temperature of 500°F. The project status, major equipment, construction schedule, construction highlights, and alternative generation concepts are discussed.

47697 (EPRI-AP—3271, pp 3.1-3.8) **Power cycle optimization study: the Geysers Power Plant.** Laszlo, J. (Pacific Gas and Electric Co., San Francisco, CA). Sep 1983. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920082. (CONF-8306177—).

From 7. annual geothermal conference and workshop; San Diego, CA, USA (28 Jun 1983).

To satisfy the requirements of the California Energy Commission (CEC) and to establish the methodology for selecting the design parameters of the next series of PG and E's Geysers Power Plant units, a power cycle optimization study was performed. Although the fundamental design principles were not altered from previous units at the Geysers (PG and E's and others'), more than 100 specific design configurations were examined over a wide range of turbine exhaust pressures and involving two different turbine designs. These are the two major variables the CEC requested to be considered. Other design parameters such as the use of twin units or different gas removal systems do not affect the process through which the optimum design backpressure is established. Gross generator output and net power plant output were calculated. Capital and operating costs were established. The incremental costs associated with lower backpressures were compared with the incremental benefits derived from the additional energy generated. The difference between these values yielded the net evaluated incremental costs over the base case design which was equivalent to Geysers Unit 20.

47698 (EPRI-AP—3271, pp 3.9-3.15) **San Diego Gas and Electric activities related to geothermal energy.** Jacobson, W.O.; Shreve, J.H.; Figueroa, R.A. (San Diego Gas and Electric, CA). Sep 1983. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920082. (CONF-8306177—).

From 7. annual geothermal conference and workshop; San Diego, CA, USA (28 Jun 1983).

In addition to the Heber Binary Project, San Diego Gas and Electric is engaged in a number of projects related to the development of geothermal power. The goal of these projects is to accelerate the development of commercial geothermal power generation in the Imperial Valley. SDG and E is achieving this goal by projects in 3 major areas. These areas are: (1) geothermal resource exploration and development, (2) geothermal power production, and (3) transmission facility development. The activities of the company in support of these activities are discussed.

47699 (EPRI-AP—3271, pp 3.16-3.17) **SCE 1983 geothermal program update.** Crane, G.K. (Southern California Edison Co., Rosemead). Sep 1983. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920082. (CONF-8306177—).

From 7. annual geothermal conference and workshop; San Diego, CA, USA (28 Jun 1983).

The activities of Southern California Edison in its geothermal program are discussed. These activities include the operation of the Brawley and Salton Sea pilot plants and on-site associated research, the resurrection of the Heber double flash plant, geothermal power purchase arrangements with third parties, and economic analysis of modular, wellsite plant versus central station units. With continued technical progress to reduce the cost of hydrothermal power production and recognition of the long-term benefits of this base load renewable energy resource, it is expected that commercial development will continue.

47700 (EPRI-AP—3271, pp 3.46-3.49) **SMUD's activities in geothermal.** Prideaux, D.L. (Sacramento Municipal Utility District, CA). Sep 1983. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920082. (CONF-8306177—).

From 7. annual geothermal conference and workshop; San Diego, CA, USA (28 Jun 1983).

The Sacramento Municipal Utility District's plans for generating facilities in which geothermal power will contribute a major source of future power additions are discussed. The utility is presently building its first geothermal unit in the Geysers called SMUDGEO No. 1. This project is 90% complete. It is estimated that the plant will cost $95 million. The construction schedule for the plant as well as some of its unique features are given. The utility's other geothermal activities are discribed such as the development of additional dry steam geothermal units in the Geysers and the Northern Nevada hot water geothermal development.

47701 (EPRI-AP—3271, pp 3.63-3.68) **Direct chlorination process for hydrogen sulfide abatement.** Sheinbaum, I.; Sims, A.V. (I. Sheinbaum Company, Inc., Monrovia, CA). Sep 1983. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920082. (CONF-8306177—).

From 7. annual geothermal conference and workshop; San Diego, CA, USA (28 Jun 1983).

The Direct Chlorination Process removes hydrogen sulfide from geothermal off-gases by reacting hydrogen sulfide with chlorine in the gas phase. Hydrogen chloride and elemental sulfur are formed by this reaction. The Direct Chlorination Process has been successfully demonstrated by an on-site operation of a pilot plant at the 3 MWe HPG-A geothermal power plant in Hawaii. Over 99.5% hydrogen sulfide removal was achieved in a single cocurrent reaction stage. Chlorine gas did not escape the pilot plant, even when 90% excess chlorine gas was used. A preliminary economic evaluation indicates that, when compared with the Stretford Process, the Direct Chlorination Process required about one-third the initial capital investment and about one-fourth the net daily expenditure. Because of the higher cost of chemicals and the restricted markets in Hawaii, the economic viability of this process in Hawaii is questionable.

47702 (EPRI-AP—3271, pp 7.3-7.7) **Economic considerations for the development of 10,000 MWe of geothermal power by 2000.** Cassel, T.A.V.; Amundsen, C.B. (Technecon, Philadelphia, PA). Sep 1983. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920082. (CONF-8306177—).

From 7. annual geothermal conference and workshop; San Diego, CA, USA (28 Jun 1983).

An approach for estimating the future growth of geothermal electric power in the US is presented. Using econometric and decision science methods and industry-supplied data, a statistically sound forecasting model was developed specifically for geothermal applications. The forecasting model sequentially addresses the following factors which directly influence the rate and extent of geothermal power development: (1) level of wildcat drilling activity in future years, (2) number of resource confirmations in future years, (3) quality of future resources, (4) quality of committed development plans of presently known and confirmed resources, (5) potential for resource development, (6) attributes of cash flow projections for resource development, (7) likelihood of resource developers and electric utilities undertaking well field and power plants projects, (8) demand for geothermal capacity, (9) pricing of geothermal power, and (10) requirements for technological advances. It is concluded that a goal of 10,000 MWe is achievable by the year 2000.

47703 (EPRI-AP—3271, pp 7.10-7.13) **Who will develop the geothermal resources?.** Suter, V.E. (Union Oil Co. of California, Los Angeles). Sep 1983. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920082. (CONF-8306177—).

From 7. annual geothermal conference and workshop; San Diego, CA, USA (28 Jun 1983).

An attempt was made to answer two questions regarding the development of geothermal resources in the US. The first question is: Can we develop 10,000 MW of geothermal power in the US? This question was answered in the affirmative. The second question is: Who will develop the geothermal resources? Those who will develop the geothermal resources can properly be called the risk takers. The qualifications of a risk-taking geothermal developer are described. It is concluded that if 10,000 MW of geothermal power are to be developed, the entire geothermal industry must take an active role in influencing legislative and regulatory activities to guard against excessive government control that could inhibit geothermal development.

47704 (EPRI-AP—3271, pp 7.14-7.17) **Technology requirements and development status: the DOE view.** Mock, J.E.; Toms, R.S.H. (Department of Energy, Washington, DC). Sep 1983. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920082. (CONF-8306177—).

From 7. annual geothermal conference and workshop; San Diego, CA, USA (28 Jun 1983).

DOE maintains a close watch on the status of geothermal technology, on the needs for advancement and innovation, and on the need for federal involvement. DOE's perception of present status is presented. Discussion of DOE's channels for assessing the needs will invite suggestions for improvement and assistance.

47705 (EPRI-AP—3271, pp 7.18-7.19) **Workshop summary: resources and reservoirs.** Lipman, S.C. (Union Oil Co. of California, Santa Rosa). Sep 1983. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920082. (CONF-8306177—).

From 7. annual geothermal conference and workshop; San Diego, CA, USA (28 Jun 1983).

A summary of the workshop discussions that attempted to answer the question: Do we have the geothermal resources to put 10,000 MWe on line by the year 2000? is presented. It was agreed that the resources have already been identified to provide 10,000 MWe. However, the group felt that the 10,000 MWe could not be on line by the year 2000.

47706 (EPRI-AP—3271, pp 7.20-7.21) **Can we develop 10,000 MWe? What are the economics?.** Sep 1983. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920082. (CONF-8306177—).

From 7. annual geothermal conference and workshop; San Diego, CA, USA (28 Jun 1983).

An overview is presented of the workshop discussions on the question: What are the economics involved in developing 10,000 MWe of geothermal power? It was agreed that economics is the single most significant factor in achieving the 10,000 MWe of generating capacity by the year 2000. The economic objectives for developing the 10 GWe by the year 2000 are discussed.

47707 (EPRI-AP—3271, pp 7.22-7.25) **Technology required to develop 10,000 MWe by the year 2000: report of the workshop chairman.** Campbell, D.A. (Republic Geothermal, Inc., Santa Fe Springs, CA). Sep 1983. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920082. (CONF-8306177—).

From 7. annual geothermal conference and workshop; San Diego, CA, USA (28 Jun 1983).

A report by the workshop chairman on the subject: What is the technology required to develop 10,000 MWe by the year 2000? is presented. The participants felt that geothermal power generation should be integrated with such things as mineral recovery, district heating, hydroponic farming, etc. in order to lower the cost of power and thereby stimulate development. It was concluded that appropriate technology will be developed to allow the 10,000 MWe goal to be reached.

47708 (EPRI-AP—3271, pp 7.26-7.27) **Role of utilities, resource companies, and government: discussion group report.** Weinberg, C.J. (Pacific Gas and Electric Co., San Ramon, CA). Sep 1983. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920082. (CONF-8306177—).

From 7. annual geothermal conference and workshop; San Diego, CA, USA (28 Jun 1983).

A discussion group report is presented that discussed the role of the utilities, resource companies, and government in developing 10,000 MWe of geothermal power by the year 2000. The generally perceived roles of the utilities would be in buying electricity, the resource developers in proving up geothermal reserves, and government in keeping law changes to a minimum.

47709 (EPRI-AP—3271, pp 4.3-4.5) **Overview of EPRI geothermal projects: noncondensable gases, steam separators, downwell pumps and wellhead power plants.** Hughes, E.E. (Electric Power Research Inst., Palo Alto, CA). Sep 1983. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920082. (CONF-8306177—).

From 7. annual geothermal conference and workshop; San Diego, CA, USA (28 Jun 1983).

EPRI conducts a research and development program to support the efforts of the electric utility industry to expand the use of the nation's geothermal resources for the generation of electricity.

The rationale, objectives, and results of some of the EPRI projects are outlined. The problems of geothermal development as well as some of the highlights of past and current projects are discussed.

47710 (EPRI-AP—3271, pp 4.10) **Heber Binary Geothermal Demonstration Plan (RP 1900).** Bigger, J.E. (Electric Power Research Inst., Palo Alto, CA). Sep 1983. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920082. (CONF-8306177—).

From 7. annual geothermal conference and workshop; San Diego, CA, USA (28 Jun 1983).

The largest field demonstration project supported by the EPRI Geothermal Power Systems Program is the 45MW(e) Heber Binary Geothermal Demonstration Plant. EPRI is providing technical and financial support to the project. The background, objective, and future directions of the project are discussed.

47711 (EPRI-AP—3271, pp 5.1-5.23) **Geothermal steam separator performance evaluation (RP 1672-1).** Awerbuch, L.; Van der Mast, V.C.; McGrath, D.P. (Bechtel Group, Inc., San Francisco, CA). Sep 1983. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920082. (CONF-8306177—).

From 7. annual geothermal conference and workshop; San Diego, CA, USA (28 Jun 1983).

The objectives of this study were to establish steam purity requirements for geothermal power plants and determine whether commercially available steam separators are capable of providing steam which meets these purity requirements. Three separators were selected for detailed analysis and field testing. These were a bottom inlet cyclone (BOC). For low- and intermediate-salinity brines with no volatility problem, it was found that the bottom inlet cyclone separation efficiency was generally adequate to provide pure steam to the turbines.

47712 (EPRI-AP—3271, pp 5.24-5.40) **Geothermal scale control using a flash-crystallizer-separator (RP 1525-2).** Van der Mast, V.C.; Awerbuch, L.; McGrath, D.P. (Bechtel Group, Inc., San Francisco, CA). Sep 1983. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920082. (CONF-8306177—).

From 7. annual geothermal conference and workshop; San Diego, CA, USA (28 Jun 1983).

The production of geothermal power from a hydrothermal resource frequently presents a serious scale control problem. Scale control methods can be based on thermodynamic or kinetic principles. EPRI is developing a scale control technique using a flash-crystallizer-separator (FCS). Design parameters for the FCS are given. The design of a single stage pilot crystallizer has been completed. The considerations that led to the specific pilot plant design are discussed. Test parameters and a proposed test plan for the FCS are presented.

47713 (EPRI-AP—3271, pp 5.41-5.53) **Field test of geothermal upstream reboiler (RP 1197-5).** Van der Mast, V.C.; Weekes, M.C.; McGrath, D.P. (Bechtel Group, Inc., San Francisco, CA). Sep 1983. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920082. (CONF-8306177—).

From 7. annual geothermal conference and workshop; San Diego, CA, USA (28 Jun 1983).

The presence of noncondensible gases in the geothermal steam has a number of adverse effects on geothermal energy recovery. An upstream reboiler is used in geothermal power plants to remove hydrogen sulfide, other noncondensible gases and particulates from the steam upstream of the turbine. By condensing the geothermal steam and reboiling clean condensate, pure steam can be fed to the turbine. The objective of this study was to determine how the key measures of reboiler performance depend on independent operating parameters over a broad range of conditions. The chemical and thermal behavior of upstream reboilers are discussed. The Cerro Prieto geothermal field was selected as the test site for the reboiler unit. The test unit and test plan are described.

47714 (EPRI-AP—3271, pp 5.54-5.57) **Cerro Prieto Field Test of H_2S removal by upstream reboiling (RP 1197-6).** Angulo, R.; Lam, L.; Mulas, P. (Instituto de Investigaciones Electricas, Baja California Norte, Mexico). Sep 1983. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920082. (CONF-8306177—).

From 7. annual geothermal conference and workshop; San Diego, CA, USA (28 Jun 1983).

The objective of this study was to determine the reboiler performance, operating with flashed geothermal steam under various conditions of pressure, temperature, gas concentration and flow ratio of steam and condensate within the unit. The technique used in measuring its performance is discussed. Inlet steam conditions, the test site, steam brine separation equipment, the chemical analysis program, and the present status of the separation equipment are described.

47715 (EPRI-AP—3271, pp 5.58-5.67) **State-of-the-art assessment of geothermal downwell pump reliability (RP 1195-8).** Ellis, P.F. II; Green, T.F. (Radian Corp., Austin, TX). Sep 1983. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920082. (CONF-8306177—).

From 7. annual geothermal conference and workshop; San Diego, CA, USA (28 Jun 1983).

The objective of this project was to determine the operating history and causes of failure of high-temperature geothermal downwell production pumps such as will be used to supply brine to geothermal binary power plants. The study also defined the probable downwell conditions that such pumps will experience, estimate the probable near-term life expectancy of such pumps, and analyze the impact of available technology on brine supply availability and capacity factors. An overview of the findings of the study is presented. It is concluded that, at this time, it is not possible to assess the impact of these novel pumps on downwell pumping.

47716 (EPRI-AP—3271, pp 5.75-5.86) **Rotary separator turbine performance and endurance test results.** Cerini, D.J.; Record, J. (Transamerica Delaval Inc., Santa Monica, CA). Sep 1983. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920082. (CONF-8306177—).

From 7. annual geothermal conference and workshop; San Diego, CA, USA (28 Jun 1983).

The rotary separator turbine is a machine which produces power from a two-phase (liquid-gas) stream, separates the liquid from the gas and pressurizes the liquid effluent. When applied to a liquid-dominated geothermal resource, the turbine offers a performance advantage over conventional flash systems, by virture of the power-producing, two-phase expansion. This turbine has been incorporated in the Biphase Wellhead Power Plant. The field test installation of the turbine as well as the field test results are described.

1509 Geothermal Engineering

REFER ALSO TO CITATION(S) 15090047670, 47676, 47686, 47687, 47688, 47689, 47690, 47692, 47693, 47709

47717 (CONF-8310177—, pp 117-125) **Geothermal reservoir definition.** Horne, R.N. (Stanford Univ., CA). Dec 1983. NTIS, PC A19/MF A01. File Number TI84005062.

From 2. annual DOE geothermal progress review meeting; Washington, DC, USA (11 Oct 1983).

The state of the geothermal reservoir definition research is summarized and the future of research in this area is postulated. Reservoir engineering procedures are considered in reference to the importance of fractures in geothermal reservoirs. Examples of field applications of reservoir engineering procedures are given. (MHR)

47718 (CONF-8310177—, pp 160-202) **Magma energy: engineering feasibility of energy extraction from magma bodies.** Traeger, R.K. (Sandia National Labs., Albuquerque, NM). Dec 1983. NTIS, PC A19/MF A01. File Number TI84005062.

From 2. annual DOE geothermal progress review meeting; Washington, DC, USA (11 Oct 1983).

A research program was carried out from 1975 to 1982 to evaluate the scientific feasibility of extracting energy from magma, i.e., to determine if there were any fundamental scientific roadblocks to tapping molten magma bodies at depth. The next stage of the program is to evaluate the engineering feasibility of extracting energy from magma bodies and to provide insight into system economics. This report summarizes the plans, schedules and estimated costs for the engineering feasibility study. Tentative tasks and schedules are presented for discussion and critique. A bibliography of past publications on magma energy is appended for further reference. 69 references.

47719 (CONF-8310177—, pp 212-234) **Hot dry rock update.** Whetten, J.; Brown, D.; Potter, R. (Los Alamos National Lab., NM). Dec 1983. NTIS, PC A19/MF A01. File Number TI84005062.

From 2. annual DOE geothermal progress review meeting; Washington, DC, USA (11 Oct 1983).

Hot-dry-rock experiments at Los Alamos, NM since 1970 are reviewed briefly, with emphasis on activities since 1977. These include hydraulic fracturing, seismic mapping, fracture mapping, and development of downhole instrumentation. (MHR)

47720 (CONF-8310177—, pp 266-287) **Geopressured geothermal well testing.** Goldsberry, F.L. (Dept. of Energy, Houston, TX). Dec 1983. NTIS, PC A19/MF A01. File Number TI84005062.

From 2. annual DOE geothermal progress review meeting; Washington, DC, USA (11 Oct 1983).

47721 (CONF-8310177—, pp 301-308) **Short term variations in drilling fluid parameters: their measurement and implications.** Williams, D.H.; Dunlap, H.F. Dec 1983. NTIS, PC A19/MF A01. File Number TI84005062.

From 2. annual DOE geothermal progress review meeting; Washington, DC, USA (11 Oct 1983).

47722 (CONF-8310177—, pp 354-362) **Geothermal well stimulation - program summary and the Beowawe experiment.** Verity, R.V. (Republic Geothermal, Inc., Santa Fe Springs, CA). Dec 1983. NTIS, PC A19/MF A01. File Number TI84005062.

From 2. annual DOE geothermal progress review meeting; Washington, DC, USA (11 Oct 1983).

Republic Geothermal, Inc. and its subcontractors have planned and executed laboratory studies and eight well stimulation field experiments under the Geothermal Reservoir Well Stimulation Program (GRWSP). The program, begun in February 1979, has concentrated on extending petroleum industry stimulation technology for use by the geothermal industry. The most recent experiment was in a naturally fractured Chevron well at Beowawe and involved an acid stimulation of a damaged interval which yielded a 2.3-fold increase in injectivity. Overall results to date have shown that stimulation is viable where adequate reservoirs are penetrated by wells encountering formation damage or locally tight formations. However, wells in marginal naturally fractured reservoirs have not been saved by the types of well stimulation jobs performed thus far. A recent discovery is that many wells can possibly be made outstanding producers by widening and propping compliant natural fractures. Confirmation of this constitutes unfinished business of the GRWSP, adn offers one of the greatest potential opportunities for enhancing the economics of geothermal power production.

47723 (CONF-8310177—, pp 363-382) **Geothermal materials development.** van Rooyen, D. (Brookhaven National Lab., Upton, NY). Dec 1983. NTIS, PC A19/MF A01. File Number TI84005062. Contract AC02-76CH00016.

From 2. annual DOE geothermal progress review meeting; Washington, DC, USA (11 Oct 1983).

47724 (EPRI-AP—3271, pp 5.87-5.93) **Radon startup analysis at a Roosevelt Hot Springs, Utah geothermal well.** Kruger, P.; Semprini, L. (Stanford Univ., CA). Sep 1983. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920082. (CONF-8306177—).

From 7. annual geothermal conference and workshop; San Diego, CA, USA (28 Jun 1983).

The evaluation of radon concentration measurements in newly developing geothermal reservoirs with the objective of determining the ability of measured changes in noncondensible gas components, such as radon, to predict changes in the thermodynamic properties of the reservoir is described. This ability would be especially useful in liquid-dominated resources, where changes in steam fraction are sensitive to changes in reservoir temperature and fluid enthalpy. Radon measurements were made in samples separated by phase at the outlets of a prototype rotary separator turbine. The data were examined in relation to the thermodynamic properties of the geofluids supplied by the test well.

47725 (LBL—17675) **Listing of scientific data on the Baca Geothermal Field.** Spencer, R.K.; Tsang, C.F. (Lawrence Berkeley Lab., CA (USA)). Jun 1984. Contract AC03-76SF00098. 142p. NTIS, PC A07/MF A01; GPO Dep. File Number DE85001925.

This document is a record of the available open-file technical data collected at the Baca Geothermal Field, New Mexico. The data base is located at the Earth Sciences Division of the Lawrence Berkeley Laboratory, Berkeley, California. This document will serve as a handbook for using the data base. Section 1 includes general reference materials such as published reports, bibliographies, and proposals. Section 2 contains various types of progress reports. Sections 3 and 4 describe individual well data: Section 3 consists of well log data (retained in both the original and digitized forms) and Section 4 lists various tests carried out in the different wells. Data in both Sections are listed by test date.

47726 (SAND—84-0956) **Numerical results for the solution of the Graetz problem for a Bingham plastic in laminar tube flow with constant wall temperature.** Blackwell, B.F. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1984. Contract AC04-76DP00789. 22p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85001883.

The Graetz problem of developing temperature profile in a tube for a fully developed laminar velocity profile has been numerically solved for a Bingham plastic. Constant properties were assumed and viscous dissipation was ignored. Results are presented for local Nusselt number, average Nusselt number, and bulk fluid temperature each as a function of axial distance from the tube inlet. The laminar Newtonian fluid is a special case of the Bingham plastic; the results presented in this article for this case appear to be more accurate than those available in the literature.

1520 Geothermal Data And Theory

REFER ALSO TO CITATION(S) 15200047701, 47726

47727 (DOE/ID/12148—T1) **Investigations of water-rock interaction in geothermal systems of Japan and Taiwan. Final report.** Liou, J.G.; Guillemette, R.N. Mar 1984. Contract FC07-80ID12148. 304p. NTIS, PC A14; 3; GPO Dep. File Number DE84011204.

Separate abstracts were prepared for individual papers. (MHR)

47728 (EPRI-AP—3271, pp 4.6-4.9) **EPRI geothermal projects overview: minerals management.** Jackson, J.M. (Electric Power Research Inst., Palo Alto). Sep 1983. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920082. (CONF-8306177—).

From 7. annual geothermal conference and workshop; San Diego, CA, USA (28 Jun 1983).

The EPRI program to study the behavior of minerals dissolved in geothermal brines is described. The goals of the program are to understand, predict, and eventually control this mineral behavior. Presently active projects are: the mobile geothermal laboratory, computer simulation of scale formation, and control of scaling. Each of these projects is described.

47729 (EPRI-AP—3271, pp 8A.1-8A.3) **Workshop: using the EPRI geothermal brine chemistry computer code EQUILIB.** Jackson, J. (Electric Power Research Inst., Palo Alto, CA). Sep 1983. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920082. (CONF-8306177—).

From 7. annual geothermal conference and workshop; San Diego, CA, USA (28 Jun 1983).

The computer code project is a part of EPRI's Geothermal minerals management subprogram. In this subprogram, an attempt is made to define, understand, and control the behavior of minerals dissolved in geothermal brines.

47730 **Plasticity and hydrolytic weakening of quartz single crystals.** Blacic, J.D.; Christie, J.M. (Geophysics Group, Los Alamos National Laboratory). *Journal of Geophysical Research;* **89**: No. B6, 4223-4240(10 Jun 1984).

The historical record and experimental data on the plasticity of quartz crystals are reviewed, including the discovery of the important phenomenon of hydrolytic weakening. Quartz deforms by slip on numerous planes, generally with Burgers vectors 1/3 <2110> and [0001]; <c+a> slip may be activated when resolved shear stresses a and c slip systems are low. Dry natural crystals deformed in an anhydrous environment are very strong, with strengths approaching the intrinsic "theoretical" values, at temperatures up to 1000 °C. Synthetic crystals with high OH concentrations and dry crystals heat-treated in a hydrogen environment are anomalously weak above a critical temperature (T/sub C/) that varies inversely with OH content. There is a transition in the preferred slip systems in crystals equally stressed for a and c slip that coincides with the hydrolytic weakening temperature (T/sub c/). Yielding and flow in all crystals below their respective critical weakening temperatures appear to be controlled by a lattice resistance mechanisms, characterized by a low activation energy and very small activation area. Above the critical temperatures, it appears that crystal flow is facilitated by diffusion of "water," or some related hydroxy defect, to the dislocations, causing hydrolysis of the strong Si-O-Si bonds and aiding bond exchange. This process may assist glide or climb of dislocations-or both-and appears to be rate-limiting. There is evidence that hydrolytic weakening is strongly influenced by confining pressure, possibly through the solubility or diffusivity of H_2O or its components in quartz.

47731 **Flow strengths of quartz aggregates: grain size and pressure effects due to hydrolytic weakening.** Kronenberg, A.K.; Tullis, J. (Department of Geological Sciences, Brown University). *Journal of Geophysical Research;* **89**: No. B6, 4281-4297(10 Jun 1984).

Novaculites and quartzite ranging in grain size from 1.2—211 μm have been experimentally deformed at confining pressures of 350—1620 MPa under conditions of constant displacement rate and constant deviatoric stress in order to determine the effect of both grain size and pressure on the rheology of quartizite. The amount of water available to the samples was varied so that flow strengths for the entire suite of samples could be compared at several, nominally equal water concentrations; samples were vacuum dried at 800 °C for 12 hours, left as is, or sealed in Pt jackets with 0.03—0.4 wt % water added. Novaculties deformed at 800 °C for 12 hours, left as is, or sealed in Pt jackets with 0.03—0.4 wt% water added. Novaculities deformed at 800 °C and $10^{0-6}/s^{-1}$ in the presence of 0.4 wt % water show a continuous decrease in flow strength with increasing confining pressure over the range 350—1590 MPa. At high confining pressures 950—1600 MPa, constant displacement rate experiments show three distinct grain size effects, corresponding to the three levels of water concentrations: (1) "grain boundary hardening" for vacuum-dried samples, (2) grain size independent strength for as is samples, and (3) "grain boundaries weakening" for samples deformed in the presence of water. Although grain boundary-dislocation interactions may lead to grain boundary hardening and grain boundary sliding to weakening the details of the mechanical data, in combination with microstructural observations, are inconsistent with existing models of intrinsic grain boundary effects.

17 WIND ENERGY

1701 Availability (climatology)

47732 **Difficulties in using power laws for wind energy assessment.** Sisterson, D.L.; Hicks, B.B. (Argonne National Lab., IL). *Solar Energy;* **31**: 201-204(1983).

Long-term data from several tall meteorological towers were used to evaluate the ability of the 1/7 power law to account for the presence of low-level nocturnal jets at heights relevant to large wind turbines. It was found that for homogeneous terrain the 1/7 law was valid, but no single coefficient generated accurate velocity extrapolations during the night. It was determined that the flow frequently decouples at night at sites around the world, and a minimum power coefficient could be determined that signaled the onset of the decoupling, which was dependent on the Obhukov length for atmospheric stability. The transition to decoupling was at times associated with the occurrence of linear wind profiles. The long-term data indicated that the decoupling begins in the evening, reaches a maximum late at night, and a normal profile returns after sunrise. The magnitude of the power coefficient varies seasonally. It is concluded that a single power law is insufficient to adequately project the power available from the wind at a given site, and that consideration should be given to the added fatigue that a rotor and hub may experience due to the uneven shear forces induced by the jet.

1706 Wind Energy Engineering

47733 **(N—84-23035) Wind energy test field Pellworm: tests of the plant Bruemmer BW 120S. Final Report.** Fries, S.; Bruegmann, J.; Petersen, G.; Mengelkamp, H.T. 1983. 49p. (In German). (GKSS—83-E-42). NTIS, PC A03/MF A01.

The wind energy converter Bruemmer BW 120S was tested on site for 25 months. Qualitative and quantitative test results are described. A definitive power curve is determined. By means of this curve the annual energy production for a site with a known annual mean wind speed can be calculated. (ESA)

47734 **(NMERDI—2-68-2215) Wind system interconnected with the Public Service Company at Deming, New Mexico. Final report.** Schoenmackers, R. Aug 1984. 120p. NTIS, PC A06/MF A01 - NMERDI Univ. of New Mexico, 457 Washington SE, Albuquerque 87108. File Number DE84901654.

In cooperation with the Public Service Company of New Mexico (PNM), the New Mexico Solar Energy Institute fieldtested a 25-kilowatt wind generator in Deming, New Mexico. The wind generator, manufactured by Carter Wind Systems, helped power an irrigation load. Wind speed, pump load, wind-generator power output, power fed into the PNM line, and reactive power requirements of pump and wind generator were monitored and recorded on magnetic tape. The wind generator produced a total of 28,997 kilowatt hours between August 1981 and December 1983. The capacity factor for that period was 6.6%. The average wind speed was lower than anticipated - 6.18 miles per hour versus 10 miles per hour recorded during five previous years. Total downtime of the wind generator was 13.5%. Power curves were measured and show a cut-in speed of between seven and eight miles per hour (manufacturer's specification: 7.5 mph) and a maximum 15-minute average power output of 21.5 kilowatts. The wind generator produced power 54.7% of the time. It supplied 4.2% of the irrigation load at the site. There is no good match between the irrigation load peak in June and July and the wind resource, which peaks in March and April. Wind-assisted irrigation may, therefore, not be feasible for the Deming area. Considering the low wind resource during the project period, the wind generator performed well and reliably. No problems were encountered in operating the wind system parallel to the utility line.

47735 **(PNL—5238) Rotationally sampled wind characteristics and correlations with MOD-OA wind turbine response.** George, R.L.; Connell, J.R. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1984. Contract AC06-76RL01830. 76p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85001770.

This report presents results of a comprehensive wind and wind turbine measurement program: the Clayton, New Mexico, vertical plane array/MOD-OA project. In this experiment, the turbulent wind was measured for a large array of fixed anemometers located two blade diameters upwind of a 200-kW horizontal-axis wind turbine (HAWT). Simultaneously, key wind turbine response parameters were also measured. The first of two major objectives of this experiment was to determine the turbulent wind, rotationally sampled to emulate the motion of the wind turbine blade, for the range of different wind speeds and stability classes actually experienced by the wind turbine. The second major objective was to correlate this rotationally sampled wind with the wind turbine blade stress and power, in order to assess the usefulness of the wind measurements for wind turbine loads testing a prediction. Time series of rotationally sampled winds and wind turbine blade bending moments and power were converted to frequency spectra using Fourier transform techniques. These spectra were used as the basis for both qualitative and quantitative comparisons among the various cases. A quantitative comparison between the rotationally sampled wind input and blade bending response was made, using the Fourier spectra to estimate the blade transfer function. These transfer functions were then used to calculate an approximate damping coefficient for the MOD-OA fiberglass blade.

47736 **(SAND—83-1909) Modeling stochastic wind loads on vertical axis wind turbines.** Veers, P.S. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1984. Contract AC04-76DP00789. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85001148.

The Vertical Axis Wind Turbine (VAWT) is a machine which extracts energy from the wind. Since random turbulence is always present, the effect of this turbulence on the wind turbine fatigue life must be evaluated. This problem is approached by numerically simulating the turbulence and calculating, in the time domain, the aerodynamic loads on the turbine blades. These loads are reduced to the form of power and cross spectral densities which can be used in standard linear structural analysis codes. The relative importance of the turbulence on blade loads is determined.

47737 **(WAOENG—83-46) Preliminary survey of wind generation in Washington: site studies and selected wind speed data.** Pierce, P.J.; James, J.W.; Kinnear, N. (comps.). Sep 1984. 132p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85000058.

Data are provided for 44 wind energy systems in six regions of the state of Washington. The data include the system's location, type of system and manufacturer, data of installation and installer, performance and operational data, dimensions, cost, factors influencing performance, and the users' response. Conclusions are drawn in regards to resource evaluation, wind turbine technology, environmental and safety considerations, institutional issues, and social considerations. Additional data are given for three wind speed measurement projects. (LEW)

47738 **Wind-electric production of nitrogen fertilizer.** Smith, M.S.; Ball, R. (NI-Lectra Corp., Dayton, OH). pp 295-302 of Second ASME Wind Energy Symposium. New York, NY, USA; A.S.M.E. (1984). (CONF-830108—).

From 6. ASME energy sources technology conference and exhibition; Houston, TX, USA (30 Jan 1983).

Alternate nitrogen fertilizer production methods, that are not dependent upon fossil fuels, need to be considered to help supply agricultural needs, particularly of small farms and remote, developing regions of the world. This paper details the project design and results of a research effort to determine the technological and economic feasibility of generating nitrogen fertilizer from wind-electric power for use on small farms. Partially funded by a U.S. Department of Energy Appropriate Technology grant, (DE-FG02-81R510308), the project combined a unique small scale electric arc/plasma nitrogen fertilizer generating process, developed by NI-Lectra Corp., with a "state of the art" wind-electric generation system to provide "on-site" production of nitrogen fertilizer. The prototype system, developed for the project, incorporates a 7.5 KW, 110 VAC wind generator mounted on a 60 ft. tower. Generated power is fed through a combination rectifier and load control to a battery bank from which power is supplied on demand, through a solid state inverter, to run the NI-Lectra nitrogen generator. A water based nitrogen solution is produced and stored in a standard 1,100 gallon polyethylene farm tank. Twenty eight test plots of corn were grown during the course of the project. Results indicate it would be possible, in one year's time, to supply the nitrogen requirements of up to 100 acres of corn in an area which has an average annual wind speed of 12 mph or greater. In areas which lack sufficient wind, a small hydro-electric generator or even solar energy could be substituted as the power source.

47739 **A new look at turbulence experienced by a rotating wind turbine.** Connell, J.R.; George, R.L. (Pacific Northwest Laboratory, Richland, Washington). pp 455-480 of Second ASME Wind Energy Symposium. New York, NY, USA; A.S.M.E. (1984). (CONF-830108—).

From 6. ASME energy sources technology conference and exhibition; Houston, TX, USA (30 Jan 1983).

A point on a rotating wind turbine blade encounters turbulence whose characteristics are in some important respects quite different from turbulence measured by a stationary anemometer. The resulting two-peaked continuous spectrum also contains narrow-band spikes of turbulence energy centered on the frequency of rotor rotation and multiples of that frequency. The probability statistics of gusts also are distinct for the rotational cases. The rotational sampling effect on wind spectra is quantified using measurements of wind velocity at circular arrays of anemometers and measurements by laser and hotwire anemometers traversing crosswind circular paths. Characteristics of fluctuating wind are compared to measured fluctuations of bending moments of a nearby horizontal-axis wind turbine rotor and power output fluctuations of the generator. The results of this work provide a basis for improving turbine design, siting and control.

47740 **SWECS tower dynamics analytical models: comparison and evaluation.** Wrighd, A.D. (DOE Rocky Flats, Wind Energy Research Center). pp 501-516 of Second ASME Wind Energy Symposium. New York, NY, USA; A.S.M.E. (1984). (CONF-830108—).

From 6. ASME energy sources technology conference and exhibition; Houston, TX, USA (30 Jan 1983).

At the Rocky Flats Wind Systems Center, several different tower dynamics analytical models are used to determine the natural frequencies and mode shapes of wind turbine towers. In this paper, these methods are described and evaluated by comparing results to tower test results. The theory of these methods is first described and then the results are shown from each method for a freestanding pole tower. The effects of changes in tower top weight will be shown. Recommendations will be made as to which methods work best for a particular type of tower. The goal of this work is to identify models which are easy to use and give acceptable results.

20 ELECTRIC POWER ENGINEERING

47741 **(DOE/RA/50276—1) Power system dispatcher modeling in the emergency state.** Jul 1984. Contract AC01-80RA50276. 124p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85002122.

A normative-descriptive model of a power system dispatcher's cognitive activities encompassing monitoring, short-term planning, and decision making during an emergency situation are described. Also reported are the details and results of a reasonableness assessment study of the dispatcher model.

47742 **(EPRI-EL—3668) User survey and implementation plan for EMTP enhancements. Final report.** Mauser, S.F.; McDermott, T.E. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Systems Technology Div.). Sep 1984. 190p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920027.

The project's objectives were to identify needed enhancements to the Electromagnetic Transients Program (EMTP) and to prepare a plan for implementing the enhancements. Written surveys and workshop discussions were conducted, resulting in the specification of 18 EMTP enhancements. General enhancement categories include user friendliness, program maintenance, and technical features. User friendliness enhancement are the most needed. Work task descriptions to implement the enhancements were written in EPRI's RFP format, and PERT charts were used to help identify significant obstacles and to prepare a coordinated development plan. A total effort of 35 personyears was esitmated to implement all 18 enhancements, including 22 personyears to implement the highest priority enhancements.

47743 (PB—84-197037) **Mastery of energy and propulsion.** (Centre de Documentation de l'Armement (CEDOCAR), 75 - Paris (France)). 1983. 74p. (In French). NTIS, PC E04/MF E01.

National Conference on Science and Defense paper presented at l'Ecole Polytechnique Palaiseau, France on April 26-27, 1983.

A review is provided of French Ministry of Defense concerns in the fields of energy and propulsion. The text covers piston engines, turbo machinery, chemical propulsion, nuclear propulsion, and electrical energy production and application.

2001 Power Plants And Power Generation

REFER ALSO TO CITATION(S) 20010047326, 47811, 47813, 47925, 48128, 48209

47744 (DOE/BP—292-Vol.1) **Indirect-fired, biomass-fueled, combined-cycle, gas turbine power plant using a ceramic heat exchanger. Volume I. Conceptual plant design and analysis. Final report.** Aug 1984. Contract FC79-83BP11189. 317p. NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE85001924.

A new technology for a wood-fueled electrical generation plant was evaluated. The proposed plant utilizes an indirectly fired gas turbine (IFGT) using a ceramic heat exchanger for high efficiency, due to its high temperature capability. The proposed plant utilizes a wood-fueled furnace with a ceramic heat exchanger to heat compressed air for a gas turbine. The configuration proposed is a combined cycle power plant that can produce 6 to 12 MW, depending upon the amount of wood used to supplementally fire a heat recovery steam generator (HRSG), which in turn powers a steam turbine. Drawings, specifications, and cost estimates based on a combined cycle analysis and wood-fired HRSG were developed. The total plant capital cost was estimated to be $13.1 million ($1640/kW). The heat rate for a 8-MW plant was calculated to be 10,965 Btu/kW when using wood residues with a 42% moisture content. Levelized electric energy costs were estimated to be 6.9 cents/kWh.

47745 (DOE/BP—292-Vol.2) **Indirect-fired, biomass-fueled, combined-cycle, gas turbine power plant using a ceramic heat exchanger. Volume II. Conceptual design drawings. Final report.** Aug 1984. Contract FC79-83BP11189. 84p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85001919.

This document includes 39 engineering drawings covering the process flow, site, layout, equipment, pipes, heat exchanger, heat recovery steam generator, etc. (DLC)

47746 (DOE/BP—292-Vol.3) **Indirect-fired, biomass-fueled, combined-cycle, gas turbine power plant using a ceramic heat exchanger. Volume III. Specifications and cost estimates. Final report.** Aug 1984. Contract FC79-83BP11189. 93p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85001923.

This report is comprised of: equipment specification, specifications for gas turbine controls, construction cost estimate, and the Hague paper describing ceramic heat exchanger technology. (DLC).

47747 (DOE/ET/29102—2) **Research on stochastic power flow study methods. Final report.** Heydt, G.T. (ed.). (Purdue Univ., Lafayette, IN (USA)). Jan 1981. Contract AC02-77ET29102. 862p. NTIS, PC A99/MF A01; 1; GPO Dep. File Number DE84016956.

This report is organized into three sections. The sections have their own table of contents which appears following a separator sheet. The separator sheets are: A Generalized Stochastic Power Flow Algorithm (This section gives a detailed description of the stochastic power flow algorithm, its implementation and use, drawbacks and limitations. Also, a computer listing is given.); Probabilistic Methods in Power System Stability (This section considers system dynamics. Many of the topics of Section 1 are rewritten in dynamic notation and solved. A computer listing gives a stochastic dynamic stability study technique.); and Stochastic Optional Energy Dispatch (This section considers optional dispatch. The optional power flow problem is rewritten considering uncertainty and the optionization problem is solved. A computer listing and a set of examples are included.).

47748 (DOE/ET/29102—2, pp 1-363) **Generalized stochastic power flow algorithm.** Sauer, P.W. Jan 1981. NTIS, PC A99/MF A01. File Number TI84016956.

Thesis.

In Research on stochastic power flow study methods. Final report.

This thesis presents a general algorithm to determine the effects of uncertainty in bus load and generation on the output of conventional power flow analysis. The use of statistical moments is presented and developed as a means for representing the stochastic process. Under this concept, statistical moments are used to describe the uncertainties, and facilitate the calculations of single and multivariate probability density functions of input and output variables. Standard distributions need not be used, although the method is applicable for most distributions which have finite moments.

47749 (DOE/ET/29102—2, pp 364-597) **Probabilistic methods in power systems dynamic stability studies.** Burchett, R.C. Jan 1981. NTIS, PC A99/MF A01. File Number TI84016956.

Thesis.

In Research on stochastic power flow study methods. Final report.

The growth of large interconnected power systems has produced considerable interest in the dynamic stability of a power system's steady state operating point. Dynamic stability studies employ the linearized state space form of the system differential equations to determine the stability of the system under normal operating conditions. In this thesis, several sources of uncertainty in electric power systems are incorporated into the dynamic stability analysis. The first- and second-order sensitivities of the eigenvalues of the linear system are used to translate the statistics of the model uncertainties into statistics of eigenvalue real parts. The form of the input statistics and eigenvalue statistics are arbitrary in that they are defined by statistical moments with the multivariate Gram Charlier Series. From this series, the probability of operating point stability is computed. The principal advantages of this method over multiple runs of a deterministic stability study are rapid computation times and a consistent method for computing the probability of operating point stability. It is shown that the set of eigenvalue statistics are valuable for identifying critical eigenvalues in a more reliable way than by complex plane location alone. The experimental results of this thesis are shown to agree well with the more time consuming and costly methods of multiple trials.

47750 (DOE/ET/29102—2, pp 598-854) **Stochastic optimal energy dispatch.** Viviani, G.L. Jan 1981. NTIS, PC A99/MF A01. File Number TI84016956.

Thesis.

In Research on stochastic power flow study methods. Final report.

This thesis presents a method to incorporate the effects of uncertain parameters into optimal energy dispatch of electric power systems. An efficient algorithm is presented, which is a direct extension of existing methods of analysis. The method employs an initial operating point by a second-order optimization procedure. Effects of uncertainty on the optimum solution are modeled by a first-order linearization. The statistics of the changes in the control vector are calculated and utilized in a Gram-Charlier series type A representation of the p.d.f. of the changes of the control vector. Various properties of the Gram-Charlier series type A are studied and a transformation is developed which improves the accuracy of the truncated Gram-Charlier series. Hence, the GCA series capabilities as a model for general p.d.f.'s are enhanced. Desired probabilities of events are calculated by direct application of the truncated GCA. An example demonstrates the suitability of this method for application to actual power systems.

47751 **(DOE/RG/10206—T1) Load management study. Final report.** Price, D.T.; Ross, D. 14 Feb 1983. Contract FG01-79RG10206. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84016832.

An indepth cost-benefit analysis of a menu of load management techniques was completed as applied to the MoPub system. An analysis of the load management hardware system currently available was done. (MHR)

47752 **(EPRI-EL—3667) Power-angle instrument for large synchronous machines. Final report.** Demcko, J.A. (Arizona Public Service Co., Phoenix (USA)). Aug 1984. 64p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920039.

The development of a low-cost, reliable generator power-angle instrument (PAI) for both steady-state and transient power-angle measurement is the subject of this report. The report includes a detailed circuit description, circuit card and overall schematics, component placement on circuit cards, and a comprehensive PAI calibration procedure. Sufficient detail is given so that a prospective PAI user may construct the instrument from the report with relative ease.

47753 **(MTR—80W76-02) Coal combined cycle system study. Volume 2. Technical evaluation.** (Mitre Corp., McLean, VA (USA). METREK Div.). Apr 1980. Contract AC01-78ET10425. 262p. NTIS, PC A12/MF A01; GPO Dep. File Number DE84012981.

The potential advantages for proceeding with demonstration of coal-fueled combined cycle power plants through retrofit of a few existing utility steam plants have been evaluated. Two combined cycle concepts were considered: pressurized fluidized bed (PFB) combined cycle and gasification combined cycle. These concepts were compared with AFB steam plants, conventional steam plants with flue gas desulfurization (FGD), and refueling such as with coal-oil mixtures. The ultimate targets are both new plants and conversion of existing plants. Combined cycle plants were found to be most competitive with conventional coal plants and offered lower air emissions and less adverse environmental impact. A demonstration is a necessary step toward commercialization.

47754 **(PB—84-193382) Reliability of creep damage assessment of power plant steam pipings.** Auerkari, P.; Vierros, P.; Salonen, J. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Metallilaboratorio). 1984. 27p. NTIS, PC E04/MF E01.

The replica technique is an attractive method for the assessment of safety and minimum life time of creep loaded power plant components. This technique must be applied with care to ensure the observation of maximum creep damage since the replica inspections are spotwise in character. If properly carried out, the replica method has the advantage of not necessarily requiring information about the stress and temperature history of the components. The assessment rules that are used for the first inspections are conservative enough but even more damage can usually be tolerated especially in small and old power plants. (Copyright (c) Valtion teknillinen tutkimuskeskus (VTT) 1984.)

47755 **(PB—84-207067) Feasibility of ultrasonic and other methods for direct measurement of condenser biofouling. Final report August 1980-October 1982.** Reeves, C.R.; Seames, W.S.; Winton, S.L. (Radian Corp., Austin, TX (USA)). May 1984. 97p. NTIS, PC A05/MF A01.

The report gives results of a literature review and laboratory studies of the potential of ultrasonic and other methods for in-situ measurement of biofouling on heat transfer surfaces (e.g., tubes) of electric utility steam condensers. Detection of the presence of biofouling in steam condensers is important for maintaining maximum heat transfer efficiency and minimizing the addition of chlorine (used to control biofouling) to meet discharge regulations. Literature relating to current industrial practices and research underway was searched to develop indirect and in-situ methods of biofouling measurement. Most methods are not sensitive enough to detect biofouling in its early stages, when it is easiest to control. A preliminary assessment indicated that this shortcoming might be avoided, using ultrasonics. An evaluation of the sensitivity of ultrasonic methods for this application confirmed the possible feasibility of this approach, but a number of questions were raised because of the lack of testing with the specific equipment needed, as well as the lack of acoustic property data on biofouling.

47756 **(MTR—80W76-01-Vol.1-Summ.) Coal combined cycle system study. Volume I. Summary.** (Mitre Corp., McLean, VA (USA). METREK Div.). Apr 1980. Contract AC01-78ET10425. 64p. NTIS, PC A04/MF A01; GPO Dep. File Number DE84012986.

The potential advantages for proceeding with demonstration of coal-fueled combined cycle power plants through retrofit of a few existing utility steam plants have been evaluated. Two combined cycle concepts were considered: Pressurized Fluidized Bed (PFB) combined cycle and gasification combined cycle. These concepts were compared with AFB steam plants, conventional steam plants with Flue Gas Desulfurization (FGD), and refueling such as with coal-oil mixtures. The ultimate targets are both new plants and conversion of existing plants. Combined cycle plants were found to be most competitive with conventional coal plants and offered lower air emissions and less adverse environmental impact. A demonstration is a necessary step toward commercialization.

2002 Environmental Aspects

REFER ALSO TO CITATION(S) 20020047282, 47335, 47339, 47340, 47344, 47345, 47351, 47537, 47943, 48497

47757 **(DOE/PC/60265—T4) Development of process for combined NO/sub x//SO/sub x/ control. Technical progress report, August 1984.** Pence, D.T. 20 Sep 1984. Contract AC22-83PC60265. 2p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84017305.

Final testing of the iron-exchanged synthetic mordenite was completed. Although the initial loading of SO_2 on the adsorbent was excellent, regeneration efforts failed to return the adsorbent to its initial loading capacity, which was near stoichiometric loading based on the iron exchange. Regeneration using various percentages of H_2, CO, and CH_4 as the reducing gas and CO_2 as the diluent were ineffective in significant adsorbent regeneration, which ultimately dropped to about 5% of the theoretical loading capacity for SO_2. When the oxygen content in the adsorption feed gas was reduced to 3%, to more closely simulate the boiler off gas, the adsorbent bed loading capacity was reduced to about 40% of theoretical loading capacity. Overall NO/sub x/ reduction of greater than 90% was maintained. Even with the use of steam as the diluent, the other reducing gases (CO and CH_4) were not effective in restoring adsorbent to satisfactory adsorbent loading capacities. The attrition test apparatus fabrication was completed and tested, and attrition testing of the unexchanged synthetic mordenite adsorbent was started.

47758 **(PB—84-189950) Buffer additives for lime/limestone slurry scrubbing: sulfite oxidation with enhanced oxygen absorption catalyzed by transition metals. Final report March 1982-March 1984.** Uhlrich, R.K.; Rochelle, G.T. (Texas Univ., Austin (USA). Dept. of Chemical Engineering). Apr 1984. 189p. NTIS, PC A09/MF A01.

The report gives results of a study of sulfite oxidation, involving the measurement of the rate of enhanced oxygen absorption across an unbroken interface into solution containing sulfite (2-100 mM) and catalyst (0.01-100 mM) at pH 4-6 and 50 C. Fe, Mn, Co, Cu and Cr ions were potent catalysts under these conditions; Ni was inactive. At 10 mM, these catalysts gave pseudo-first order (in oxygen) rate constants of 8.6, 43, 4.7, 95 and 11 sec, respectively. Dry catalyst added in its upper valence state (ferric, cupric, chromic) produced high initial rates that fell in 1 to 6 hours to steady state, while catalyst added in its lower state (ferrous, manganous, cobaltous) showed no high rates and reached steady state in less than 1 minute. Ferric and ferrous eventually resulted in the same rate. Fe was a much stronger catalyst than Mn or Co, but its rate was limited by Fe solubility of about 0.01 mM at pH 5, resulting in an enhancement factor of 2.4 at all higher concentrations. Thiosulfate (0.05-1 mM) had a stronger inhibiting effect and efficiency on Mn than on Fe. EDTA was an effective inhibitor for Fe at equal or greater concentrations. Rates for Fe and Co increased with pH from 4 to 5, while those for Mn were unchanged. Strong positive Mn-Fe synergisms were found to cause absorption rates of up to five times those expected.

47759 **(PB—84-207638) Impacts of coal combustion on trace elements in the environment: Wisconsin power plant impact study.** Helmke, P.A.; Robarge, W.P.; Schoenfield, M.B.; Burger, P.; Koons, R.D. (Wisconsin Univ., Madison (USA)). Jun 1984. 114p. NTIS, PC A06/MF A01.

Prepared in cooperation with Madison Gas and Electric Co., WI, Wisconsin Public Service Corp., Green Bay, Wisconsin Public Service Commission, Madison, and Wisconsin Dept. of Natural Resources, Madison.

The impact of a modern coal-fired generating station on the environment, with emphasis on the concentrations and behavior of elements and the disposal of fly ash, was determined by analysis of aerosolic dust, oak leaves, aquatic organisms, water, fly ash, and coal. The major analytical techniques used were neutron activation analysis, x-ray fluorescence analysis, atomic absorption spectrophotometry, electron microscopy, and x-ray diffraction. Calcium, Ba, B, and Th concentrations were relatively high in the fly ash produced. When mixed with water, the fly ash reacts to form a cement-like material that includes pozzolanic mineral phases that were identified by x-ray diffraction and electron microscopy. Aerosolic dust collected in fallout buckets was enrined with Br, Hg, Sb, Se, Th, U, and Zn. Of the organisms tested, Asellus racovitzai and Odanata were most suitable for monitoring ecosystem trace element fluxes. Barium, Cr, Sc, and possibly Sb concentrations were higher in specimens of these organisms exposed to the ash effluent than in control specimens. These increases cannot be attributed to seasonal variability, sample contamination or differences in specimen size and are therefore thought to result from exposure of the organisms to ash effluent. Potential effects of fly ash from the Columbia Generating Station or other aerosolic dust on the concentrations of elements in oak leaves could not be detected.

2003 Power Transmission And Distribution

REFER ALSO TO CITATION(S) 20030047747, 47748, 47749, 47750

47760 **(BNL—51753) Semiannual report for the period April 1, 1983 to September 30, 1983: superconducting power transmission system development; cable insulation development.** (Brookhaven National Lab., Upton, NY (USA)). 27 Feb 1984. Contract AC02-76CH00016. 112p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE84017184.

The objective of the program is to develop an underground superconducting power transmission system which is economical and technically attractive to the utility industry. The system would be capable of carrying very large blocks of electric power, thus enabling it to supplant overhead lines in urban and suburban areas and regions of natural beauty. The program consisted initially of work in the laboratory to develop suitable materials, cryostats and cable concepts. The materials work covers the development and testing of suitable superconductors and dielectric insulation. The laboratory work has now been extended to an outside test facility which represents an intermediate step between the laboratory scale and a full-scale system. The development of a cable insulation using gas-impregnated lapped polymeric tapes commenced several years ago at BNL as a direct consequence of the program to design a flexible ac superconducting power transmission cable. During these years a better understanding was gained of the problems of lapping film plastic tapes and the associated properties and characteristics required of the tape material. In addition, a great deal of both room temperature and low temperature high-voltage testing was performed. It is now apparent that much of this work is applicable to design of superior high-voltage power transmission cables specifically designed for operation at room temperature. Impregnants other than helium are being investigated, especially hydrocarbon oils, as potential room-temperature components. Electrical testing of small samples has demonstrated the superior electrical performance of the plastic tape insulation compared to kraft paper. The thermal properties and oil impregnation problems have been investigated. A test loop for a full-scale cable has been installed and a trial cable about 150 ft long has been made with a rating of ~ 230 kV. The cable was installed in the loop and potheads fitted during the reporting period.

47761 **(CONF-840706—5) Design of an integrated distribution control system.** Purucker, S.L.; Reddoch, T.W.; Detwiler, J.S.; Monteen, L.D. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84015405.

From Power Engineering Society summer meeting; Seattle, WA, USA (15 Jul 1984).

In an effort to supply electric power at minimum cost, the electric utility industry continues to examine techniques that will allow the power system to operate more effectively and efficiently. In recent years, interest has developed in automated methods to facilitate the planning and operation of electric power systems. These techniques include the Supervisory Control and Data Acquisition system (SCADA) for distribution and transmission systems, centralized generation control and dispatch (Energy Management Systems), distribution automation and control, load control, and thermal energy storage. In general, each area has been approached as an independent entity. The intent of the Athens Automation and Control Experiment (AACE) is to integrate many of the new automation concepts into a single control system, to develop and implement various control strategies, and to quantify the benefits of these control strategies. Particular focus is placed on a distribution energy control center and its coordination with bulk power operations.

47762 **(DOE/NBB—0065) Program plan for research and development of HVDC power systems and components.** (Oak Ridge National Lab., TN (USA)). Jan 1984. Contract W-7405-ENG-26. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84016735.

The Division of Electric Energy Systems (EES) of the US Department of Energy (DOE) has formulated a program for research and development (R and D) of high-voltage direct-current (HVDC) power transmission and delivery systems and associated dc components. The program includes analysis of future utility system applications, development of new HVDC control and protection concepts, and advanced dc component research. The structure of this program will provide an appropriate balance between mid- and long-term options for the enhancement of HVDC power transmission and delivery for future electric power systems. This HVDC research program is intended to further develop and improve an important energy transport technology, one that will offer many opportunities to reduce future energy costs. The economics and operating constraints in alternating-current (ac) solutions strongly indicate that new HVDC technology options will be advantageous and will provide an enhanced ability to use generation and transmission system resources efficiently and economically in existing electric energy systems. Studies show that further development of this technology will lead to significant integration of new HVDC techniques into existing electric energy systems with appreciable economic and technical benefit. The R and D proposed in this HVDC Program Plan will be of substantial value to future electric power systems.

47763 **(EPRI-EL—3501) Characterization of failed solid-dielectric cables: Phase 1.** Stember, L.H. (Battelle Columbus Labs., OH (USA)). Aug 1984. 178p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920026.

The primary of Phase I was to identify the factors that the field reliability of high-MW PE (HMWPE) and crosslinked PE (XLPE) underground distribution cables by analyzing historical field data on insulation failures. These data were collected from a group of 15 utilities. The information was entered into a computer data base which made it readily available for statistical analysis. Various analyses were conducted, and statistically significant results which identified predictor variables for failure rates were obtained for HMWPE insulated cables. Predictors were suggested by the analysis for XLPE insulated cables, but at a lower level of statistical significance. Voltage breakdown tests and analytical laboratory work are planned on field-aged XLPE cables in Phase II. Some field-aged HMWPE samples will also analyzed in the laboratory.

47764 **(EPRI-EL—3608-CCM-Vol.2) Single-phase, multiphase, and multiple-circuit lightning flashovers of transmission lines. Volume 2. User's manual.** Anderson, J.G.; Durbak, D.W. (General Electric Co., Schenectady, NY (USA). Electric Utility Systems Engineering Dept.). Aug 1984. 82p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920036.

This MULTI-FLASH Users Manual is written to permit simple and effective utilization by new users of the EPRI MULTI-FLASH 77 program to calculate the lightning response of transmission towers. It is based on the probability theory and tower flashover calculation algorithm described in EPRI Research Project 2080-1 Single and Multiple Phase and Multiple Circuit Lightning Flashover of Transmission Lines - Final Report, April 1983. After a brief description of the program, all the input data sheets are displayed, along with three sample cases, to familiarize the user with the required procedures. Inputting is very easy and mistakes are correctable at any time prior to the actual problem solution. For multiple cases, the data for each preceding case is retained, so the user only has to change those parameters that actually change as the case changes. This makes it simple to run multiple cases with a minimum of typing. In the appendices, the theory of describing towers by networks of their elements is outlined, and the statistics used in calculating tower footing resistance distributions is discussed.

47765 **(EPRI-EL—3608-Vol.1) Single-phase, multiphase, and multiple-circuit lightning flashovers of transmission lines. Volume I. Engineering analysis. Final report.** Anderson, J.G.; Durbak, D.W. (General Electric Co., Schenectady, NY (USA). Electric Utility Systems Engineering Dept.). Aug 1984. 98p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920032.

This two-volume report presents the theory of computer computation of simultaneous multiphase or multiple-circuit lightning flashover of transmission lines. This theory is implemented in a special computer program developed for EPRI to predict the probabilities of flashover of all combinations of up to 12 phases on one transmission tower. Either ac, dc, or any combination of ac and dc can be evaluated. The algorithms are developed to handle unusual tower geometries so that designs can be evaluated for minimizing the likelihood of simultaneous double-circuit lightning flashover. The program is available in FORTRAN 77. It is applicable to any transmission line containing at least one overhead shield wire. Volume 1 is the engineering analysis, and Volume 2 is the user's manual.

47766 **(EPRI-EL—3643) Advanced light-triggered thyristor. Final report.** Temple, V.A.K. (General Electric Co., Schenectady, NY (USA). Corporate Research and Development Center). Aug 1984. 134p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920475.

The ultimate aim of the earlier phases (I and II) of EPRI contract RP669-2 was to develop a light triggered thyristor capable of one for one replacement of electrically triggered thyristors in the demanding HVDC application where hundreds of thyristors are connected in series and must be turned on and commutate off simultaneously. This goal was accomplished with the 2.6 kV, 1000 A EPRI-GE4 light triggered thyristor (LTT) described in an interim report. However, as higher voltage thyristors were developed, this 2.6 kV LTT became obsolete. Thus our new goal was set at 5 kV. Actually, a part of the Phase II program was to investigate means to scale up in voltage to 5 kV and to eliminate protective circuitry, where possible, by incorporating protective functions into the thyristor, particularly VBO (Voltage Break-Over) protection. Since both 5 kV turn-on and VBO protection involved safe turn-on at high voltages, these two problems are qualitatively similar. During the current program we also laid the foundation for ion implant processing and began work on a more effective edge termination technique which, if combined, could lead to both higher current and voltage ratings from the same starting wafer. Such improvements as ion implant processing and new breakdwn voltage technology are keys to higher voltage thyristors in the same way that controlled turn-on is the key to safe turn-on, whatever the device voltage rating. All phases of this program have been greatly assisted by a huge GE computer modeling commitment, a commitment which led, in less than six months from the GE11 device failures, to the GE13 device success. In higher voltage device development such a capability is even more critical because of the general increase in process difficulty and cost.

47767 **(NBSIR—84-2898) Development of power system measurements. Quarterly report, January 1, 1984-March 31, 1984.** Hebner, R.E. (ed.). Jul 1984. Contract AI01-76PR06010. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE84017001.

This report documents the progress on three technical investigations sponsored by the Department of Energy and performed by the Electrosystems Division, the National Bureau of Standards. The work described covers the period from January 1, 1984 to March 31, 1984. The report emphasizes the performance of ion counters like those used to measure the ions near dc transmission lines, the production rates of oxyfluorides in SF$_6$ corona discharges, and the measurement of space charge associated with a pressboard interface in transformer oil.

47768 **(ORNL/Sub—84-17457/1) Advanced metal oxide varistor concepts. Final report.** Philipp, H.R.; Mahan, G.D.; Levinson, L.M. (General Electric Co., Schenectady, NY (USA). Research and Development Center). Jul 1984. Contract AC05-84OR21400. 77p. NTIS, PC A05/MF A01; GPO Dep. File Number DE84016677.

Zinc oxide varistors are ZnO-based ceramic semiconductor devices with highly nonlinear current-voltage characteristics similar to back-to-back Zener diodes but with much greater current, voltage, and energy-handling capabilities. Zinc oxide varistors have proven useful in a variety of applications, particularly as high-quality voltage suppression devices for the protection of ac and dc electric power transmission systems against the effects of transient overvoltages due to switching surges and lightning strikes. In the work described in this report, we have chosen to study simple varistor systems that use Bi or Pr as the varistor-forming additive and Co or Mn as the varistor-performance ingredient. Commercial varistor materials generally use Bi as the varistor-forming ingredient, and the sintering process in such material probably proceeds in the liquid phase. Varistor materials that use Pr as the varistor-forming ingredient are also produced commercially. However, owing to the high melting point of Pr$_2$O$_3$ compared to Bi$_2$O$_3$, sintering in these materials probably takes place in the solid state. The performance ingredients Co and Mn are present in almost all commercial mixes. Co is an interesting choice because it is known to introduce a deep level into ZnO, giving such varistors a green color.

21 NUCLEAR POWER PLANTS

47769 **(AD-A—141719/5) Inspection policies for stand-by systems. Technical report.** Thomas, L.C.; Jacobs, P.A.; Gaver, D.P. (Naval Postgraduate School, Monterey, CA (USA)). Mar 1984. 67p. (NPS—55-84-004). NTIS, PC A04/MF A01.

An auxiliary service unit is normally idle, or in cold standby. If a demand for the unit's service occurs, the unit must be available to satisfy it, or else catastrophe occurs. Policies for periodic inspection and maintenance of such a unit are derived in this paper that maximize the expected time until a catastrophe occurs. The policies recognize that inspection, maintenance, and repair periods are of non-zero duration, during which the unit is vulnerable. These also account for the possibility of hazardous inspection that may damage the unit, and various forms of imperfect repair. Important examples occur in the nuclear power industry: a unit may be a pump, or emergency diesel generator, and a demand may be caused by an initiating event such as pipe break or loss of off site power; catastrophe equates to loss-of coolant accident or melt down. Other examples occur in the military, and in emergency services to hospitals.

47770 Place of nuclear power in the Reagan Administration's energy policy. Hodel, D.P. *Public Utilities Fortnightly;* **114**: No. 8, 21-25(11 Oct 1984).

A balanced and mixed energy supply is a major goal of the present national energy policy, and nuclear power must continue to be a viable power supply option, according to the Secretary of the US Department of Energy. Here the author reviews the status of the nuclear industry and describes recent federal efforts to remove disincentives for the construction of nuclear power plants. Motivated by the desire to reduce dependence on oil, DOE has taken action to ensure quality construction of nuclear facilities, provide greater stability for electric utilities, and foster private investment in needed generating capacity.

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 21010047806, 47809, 47810, 47811, 47836, 47859, 47860, 47862, 47871, 47873, 47881, 47989

47771 (DOE/ET/34006—T1) Extended Burnup Demonstration Reactor Fuel Program: results of fission gas release measurements at Big Rock Point, September 1982. Garber, D.E. (Consumers Power Co., Jackson, MI (USA); Exxon Nuclear Co., Inc., Richland, WA (USA); GPU Nuclear Corp., Parsippany, NJ (USA)). 18 Jul 1984. Contract AC02-79ET34006. 99p. (XN-NF—84-10). NTIS (US Sales Only), PC A05/MF A01; 1; GPO Dep. File Number DE84014403.

Under the program, standard ENC-fabricated reload fuel in the Big Rock Point and Oyster Creek cores is to be irradiated to discharge burnups in excess of 35,000 MWD/MTU, one to two cycles beyond its originally projected exposure life. The program provides for examination of the fuel at poolside before and after each extended burnup cycle as well as for limited destructive examination in hot cells. This report documents results of fission gas measurements taken at the Big Rock Point reactor at EOC 17 in September 1982. Twenty-five extended burnup fuel rods were punctured at poolside and fission gas temperature, pressure and volume measurements were obtained. In addition, fission gas samples were collected from each punctured fuel rod for isotopic analysis. Percent fission gas releases and isotopic analyses are presented, and the relationship between fission gas release and fuel power history and burnup is investigated. In addition, helium generation rates and xenon-to-krypton ratios in the fission gas are examined.

47772 (DOE/ET/34031—17) BWR fuel bundle extended burnup program. Technical progress report, January-December 1983. Baumgartner, J.A. (comp.). (General Electric Co., San Jose, CA (USA). Nuclear Engineering Div.; Northern States Power Co., Minneapolis, MN (USA)). May 1984. Contract AC02-80ET34031. 73p. (GEAP—30643). NTIS (US Sales Only), PC A04/MF A01; 1; GPO Dep. File Number DE85001803.

The high burnup fuel bundles in this program completed their planned operation in the Monticello Nuclear Generating Plant and were discharged in September 1982 with average burnups of up to 45.6 GWd/MTU. Program activities during the 1983 reporting period included the final fuel examination at the Monticello site, hot cell examination of twelve fuel rods at the Battelle Columbus Laboratories, and fuel rod nondestructive examination work and spacer testing at the Vallecitos Nuclear Center. Results of the examination and testing work are summarized.

47773 (EPRI-NP—3614-Vol.2) Repair welding of heavy-section steel components in LWRs. Volume 2. Detailed technical description of thw work. Research Project 1236-1. Final report. Feldstein, J.G. (Babcock and Wilcox Co., Alliance, OH (USA). Research and Development Div.). Jul 1984. 468p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920513.

An EPRI-sponsored program was carried out by Babcock and Wilcox to develop an alternative weld repair procedure to the half bead technique suitable for in-service repair of nuclear reactor pressure vessel components without subsequent post weld heat treatment. The new weld repair procedure uses conventional machining for defect excavation/cavity preparation and the cold wire gas tungsten-arc process as the weld method. A controlled heat input, multi-pass welding procedure produces excellent grain refinement and tempering of the base metal HAZ without the necessity for grinding the first layer. The cavity preparation and weld repair processes combined with the elimination of grinding gives a significant advantage to the implementation of this new repair procedure in a radioactive environment. A characterization of the mechanical properties for weldments representative of the half bead technique and the new alternate repair procedure included both conventional and fracture mechanics based testing. The data indicates that both repair procedures are capable of producing repair weldments having material properties adequate for service in nuclear pressure boundary components.

47774 (EPRI-NP—3687) BWR corrosion-product transport survey. Final report. Anstine, L.D.; Zimmer, J.J.; Wong, T.L. Sep 1984. 274p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920028.

The literature on BWR corrosion product transport was reviewed. The available data in six major areas are compiled in consistent units and formats. Statistical measures and trends with time of key parameters are presented. Potential correlations between 24 parameters are investigated. The implications of the data analyses and correlations are discussed.

47775 (IWGFPT—18) Pellet cladding interaction in water reactor fuel. (International Atomic Energy Agency, Vienna (Austria)). May 1984. 236p. (CONF-8310235—). NTIS (US Sales Only), PC A11/MF A01. File Number DE84901766.

From IAEA specialists' meeting on pellet-cladding interaction in water reactor fuel; Seattle, WA, USA (3 Oct 1983).

Papers are presented concerning pellet-cladding interaction testing and results; alternative fuel designs and operational strategies to improve pellet-cladding interaction (PCI); experimental investigations and mechanistic studies; and PCI modelling and failure criteria.

47776 (NUREG—1061-Vol.1) Report of the US Nuclear Regulatory Commission Piping Review Committee. Volume 1. Investigation and evaluation of stress corrosion cracking in piping of boiling water reactor plants. (Nuclear Regulatory Commission, Washington, DC (USA)). Aug 1984. 398p. NTIS, PC A17/MF A01 - GPO* $8.50. File Number TI85900069.

IGSCC in BWR piping is occurring owing to a combination of material, environment, and stress factors, each of which can affect both the initiation of a stress-corrosion crack and the rate of its subsequent propagation. In evaluating long-term solutions to the problem, one needs to consider the effects of each of the proposed remedial actions. Mitigating actions to control IGSCC in BWR piping must be designed to alleviate one or more of the three synergistic factors: sensitized material, the convention BWR environment, and high tensile stresses. Because mitigating actions addressing each of these factors may not be fully effective under all anticipated operating conditions, mitigating actions should address two and preferably all three of the causative factors; e.g., material plus some control of water chemistry, or stress reversal plus controlled water chemistry.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

REFER ALSO TO CITATION(S) 21020047773, 47775, 47804, 47806, 47809, 47810, 47811, 47824, 47837, 47838, 47846, 47852, 47855, 47858, 47861, 47865, 47866, 47871, 47874, 47878, 47881, 47884, 47889, 47892, 48404

47777 (CEA-CONF—7166) **Application of ultra-sons to on-site spent fuel assemblies metrology.** Gondard, C.; Saglio, R.; Vouillot, M.; Delaroche, P.; Vaubert, Y.; Van Craeynest, J.C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Dec 1983. 22p. (In French). (CONF-831175—9). NTIS (US Sales Only), PC A02/MF A01. File Number DE84751759.

From 6. international conference on nondestructive evaluation in the nuclear industry; Zurich, Switzerland (27 Nov 1983).

Fuel assemblies inspection on the site of a power reactor, between two irradiation campaigns, allows to estimate the behaviour of prototype fuel assemblies and to permit their refueling for the continuation of the irradiation; the utilization of non-destructive, reliable and high-performance techniques, is of a great interest in the application. For, this reason, the C.E.A. has been led to carry out new techniques allowing the visual examination and the dimensional inspection of spent fuel assemblies of 900 MWe French pressurized water reactors, with a transportable Fuel Examination Module (MEC) on every reactor site. This module includes a television camera, and uses for the first time as "position sensor" the properties offered by a set of ultrasonic transducers. The main principle of the design, of the operation way of the module, of the measuring methods, and, of the data acquisition and processing, are presented.

47778 (EPRI-CS—2931) **Characterization of operational environment for steam turbine-blading alloys.** Jonas, O.; Pebler, A. Aug 1984. 182p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920048.

Steam and water from 42 units were sampled and analyzed to establish concentrations of chloride, sulfate, sodium, phosphate, ammonia, silica, and oxygen, and pH at steady load. Liquid ion chromatography, sensitive from 1 ppB up, was used for the ionic species. To identify concentrated compounds and their mixtures which exist on turbine surfaces, deposits from 105 turbines were analyzed by x-ray diffraction, semiquantitative emission spectroscopy, and by wet chemical methods. A survey of water treatment and water and steam specifications provided information on system characteristics, typical system chemistries as analyzed by operators, and a list of 28 steam and water specifications which reflect anticipated steam chemistry limits. The transport of chemicals in steam power systems and impurity behavior in turbines are described. The average concentration of chlorides, sulfates, phosphates, and sodium in LP steam was found to be less than 10 ppB. 60% of all units tested met the Westinghouse 5 ppB limit for chloride and sodium. This and previous work identified 160 chemical compounds in steam or deposits: sodium hydroxide, sodium and ammonium chlorides and sulfates, and organic and inorganic acids. Copper oxides, which can aggravate corrosion, are frequently present. The environments can be acidic, basic, oxidizing or reducing. Units with blade failures have higher concentrations of chlorides and sulfates in deposits. Carryover of chlorides and sulfates from boiler drum and PWR recirculating steam generators is higher than expected, resulting in acidification of turbine steam. Carryover of phosphate is very low.

47779 (EPRI-NP—3274-Vol.2) **Determination and verification of required water chemistry limits. Volume 2. Isothermal capsule testing. Final report.** Fink, G.C.; Helyer, M.H. (Combustion Engineering, Inc., Windsor, CT (USA). Nuclear Power Systems). Aug 1984. 128p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920016.

Four series of high temperature (560°F), isothermal capsule tests were performed in order to quantitatively measure and assess the corrosion behavior of various current and new steam generator materials in potentially aggressive environments. Alloy 600 capsules coupled to AISI 1018 carbon steel, A-508 low alloy steel or Types 405 and 409 stainless steels were used for these tests. The chemical environments selected simulated those which could occur within a steam generator following instances to condenser inleakage from three broad categories of cooling waters (acid forming - sea/brackish waters, neutral to caustic forming - fresh waters and cooling tower treated fresh water). Results of testing indicate: Pitting was the predominant type of corrosion for Alloy 600, A-508 low alloy steel, AISI 1018 carbon steel and Types 405, 409 stainless steel. AISI 1018 carbon steel experienced nonprotective magnetite formation in an acid chloride (0.2 M $MgCl_2$) environment. Non-protective magnetite formation was not experienced at 0.01 M $MgCl_2$. Type 409 stainless steel was found to be susceptible to intergranular attack in two of the environments tested (0.1 M SiO_2 plus 0.1 M NaC1, and cincentrated (10X) Arkansas cooling tower water preacidified to pH 6.5 with H_2SO_4). Type 405 stainless steel was not similarly affected. A-508 Class 2 low alloy steel demonstrated the greatest propensity for pitting followed by Type 405 stainless steel, AISI 1018 carbon steel and Type 409 stainless steel.

47780 (EPRI-NP—3274-Vol.4) **Determination and verification of required water chemistry limits. Volume 4. Model boiler 5A tests. Research Project S111-1. Final report.** Sireci, J.E.; Klisiewicz, J.W. (Combustion Engineering, Inc., Windsor, CT (USA). Nuclear Power Systems). Aug 1984. 107p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920017.

The potential deleterious effects on steam generator materials of construction associated with the conversion from phosphate chemistry control to the now widely accepted All Volatile Treatment (AVT) method was evaluated in a model boiler test. The test initiated operation on phosphate chemistry and subsequently changed to AVT chemistry control and utilized a source of condenser cooling water which produces acidic conditions. After 272 days of steaming (45 days with phosphate and 227 days with faulted AVT chemistry control plus synthetic corrosion product additions) at steam generator secondary temperatures and pressures, the unit was destructively examined. Total chloride exposure was 1981 ppM chloride days. Non-protective magnetite growth which resulted in tube denting was observed within the carbon steel drilled support plate annuli. Significant pitting of ferritic 405 stainless steel drilled plate and 409 stainless steel eggcrate system was also observed; neither of these support systems corroded to the point where tube denting occurred. No corrosion of the heat transfer tube surfaces was noted. Deposit analysis indicate an accumulation of typical sea salt and synthetic corrosion products in steam blanketed areas. Utilizing prototypic commercial steam generator thermal hydraulic and chemistry conditions, steam generator tube denting and carbon steel drilled support plate deformation can be duplicated under laboratory conditions. Under comparable test conditions, 405 and 409 stainless steels have been shown to be more resistant to non-protective magnetite formation than carbon steel.

47781 (EPRI-NP—3274-Vol.5) **Determination and verification of required water chemistry limits. Volume 5. Model boiler 5B tests. Final report.** Patel, B.M.; Grondahl, E.D. (Combustion Engineering, Inc., Windsor, CT (USA). Nuclear Power Systems). Aug 1984. 277p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920023.

A model boiler test was performed to determine the potential deleterious effects of synthetic corrosion products and low level chloride additions on steam generator materials, when the generator is operated under All Volatile Treatment (AVT) chemistry. The first indication of tube denting was provided by a positive strain gauge response within the carbon steel drilled support plate after 21.4 ppM-chloride days (294 steaming days). All tubes passing through the carbon steel drilled support plate were found to be dented by profilometry after 47.5 ppM-chloride days exposure (462 steaming days). A reduction in the average bulk water chloride concentration from 0.18 to 0.06 ppM, once active tube denting had been initiated, did not result in a decease in carbon steel corrosion and tube denting. Enhanced heat flux operation, nominal 50 to 80 KBtu/hr-sq.ft, did not affect the carbon steel corrosion or the rate of tube denting. Carbon steel drilled support plate ligament cracking was observed after 52.3 ppM-chloride days of exposure (530 steaming days) as a result of stresses generated from the formation of non-protective magnetite in the tube/support annuli. There was no evidence of accelerated corrosion of the 405 stainless steel drilled support plate, 409 stainless steel eggcrate support and carbon steel eggcrate support systems.

47782 **(EPRI-NP—3642-SR) Few-group baffle and/or reflector constants for diffusion calculation application.** Eich, W.J.; Williams, M. (Electric Power Research Inst., Palo Alto, CA (USA); Louisiana State Univ., Baton Rouge (USA). Nuclear Science Center). Aug 1984. 60p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920019.

Analysis of critical experiments for cross-section evaluation has been conducted on the basis of one dimensional four-group diffusion theory calculations which explicitly model the homogenized core and reflector in the radial plane. Such analyses require a reflector representation that models the leakage process as accurately as is feasible. This report describes the development and testing of few-group ENDF/B-V based light water reflector constants for use in diffusion theory which have been derived so as to reproduce leakage and other reaction rates from reference multifast group transport calculations. This work has been extended to parameterize similar higher order transport calculations with two- or four-group constants valid for application to typical PWR baffle/reflector configurations as represented in coarse mesh diffusion (PDQ) representations.

47783 **(INIS-mf—9055) Nuclear economics in a nutshell.** Birkby, E. (UKAEA Economics and Energy Studies Branch, Harwell). 1984. 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84780618.

Two main questions are discussed from the economics viewpoint; how the Central Electricity Generating Board (CEGB) decides which of its electricity generating stations to run to meet the demand for electricity at any point in time; and how the CEGB analyse possible future investments in new generating capacity. These questions are considered generally and then with the particular case of the proposed Sizewell B PWR reactor in mind. The cost of producing electricity has three components, the capital cost, the fuel cost and operating cost. These must be considered using meaningful and comparable figures.

47784 **(NUREG/CR—1829) Eddy-current inspection for steam generator tubing program. Quarterly progress report for period ending June 30, 1980.** Dodd, C.V.; Deeds, W.E.; McClung, R.W. (Oak Ridge National Lab., TN (USA)). Dec 1980. Contract AC05-84OR21400. 8p. (ORNL/NUREG/TM—421). NTIS, PC A02/MF A01 - GPO. File Number TI84017651.

Eddy-current methods provide the best in-service inspection of steam generator tubing, but present techniques can produce ambiguity because of the many independent variables that affect the signals. The current development program has used mathematical models and developed or modified computer programs to design optimum probes, instrumentation, and techniques for multifrequency, multiproperty examinations. Interactive calculations and experimental measurements have been made with the use of modular eddy-current instrumentation and a minicomputer. These establish the coefficients for the complex equations that define the values of the desired properties (and the attainable accuracy) despite changes in other significant variables. The computer programs for calculating the accuracy with which various properties can be measured indicate that the tubing wall thickness and the defect size can be measured much more accurately than is currently required, even when other properties are varying. Our experimental measurements have confirmed these results, although more testing is needed for all the different combinations of cases and different types of defects. We are continuing to design and construct instrumentation systems that will be used in the field.

47785 **(NUREG/CR—3888) Analysis of the VENUS PWR Engineering Mockup Experiment - Phase I: source distribution.** Morakinyo, P.O.; Williams, M.L.; Kam, F.B.K. (Oak Ridge National Lab., TN (USA)). Aug 1984. Contract AC05-84OR21400. 80p. (ORNL/TM—9238). NTIS, PC A05/MF A01 - GPO. File Number TI84015873.

The neutron fission source distribution in the core of the VENUS PWR Mockup Experiment is computed and compared to experimental measurements. This experiment is an important component of the USNRC's program goal of benchmarking reactor pressure vessel (RPV) fluence calculations in order to determine the accuracy to which RPV damage can be computed. Of particular concern is the accuracy of the source calculation near the core-baffle interface. Calculations were performed with two-dimensional discrete ordinates transport theory, using cross sections based on ENDF/B-IV data. In addition to in-core fission rate calculations, several ex-core fission chamber responses were computed. The accuracy of the calculations were evaluated by comparison with the experimental measurements. Results indicate that the calculated neutron source distribution within the VENUS core agrees with the experimentally measured values with an average error of less than 3%. At the important core-baffle interface, the agreement is within 3% error, except at the baffle corner, where the error is about 6%. The ex-core results are also in good agreement with measurements, except at the circular steel barrel, which was approximated into a rectangular geometry. It was discovered that a better accuracy in the calculations can be obtained by applying a detailed space dependent cross-section weighting procedure to the core-baffle interface region. Using this cross-section weighting in a two-dimensional transport theory calculation of a well-defined LWR core, the maximum error introduced into the predicted RPV fluence due to source errors should be on the order of 5%. However, in power reactor analysis, additional complexities (such as the time-dependent core composition and the use of few group diffusion theory) could affect this uncertainty value.

47786 **(PNL—5211) Review and evaluation of Transamerica Delaval, Inc., diesel engine reliability and operability - Catawba Nuclear Station Unit 1.** Nesbitt, J.F. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1984. Contract AC06-76RL01830. 102p. NTIS (US Sales Only), PC A06/MF A01; GPO Dep. File Number DE85001779.

Section 2 of this report provides relevant background information on the known problems and efforts toward their resolution by both Duke and an ad hoc group of similar TDI engine owners (the TDI Owners' Group) who have united their efforts in regard to these mutual concerns. Section 3 presents a review and evaluation of specific problems experienced on the Catawba engines as well as of activities pertaining to the TDI Owners' Group generic components. Section 4 reviews Duke Power Company test and inspection activities on the 1A engine. Section 5 reviews the activities Duke has conducted or plans to perform on the 1B engine. Section 6 documents PNL's evaluation of Duke's post-inspection engine tests. Section 7 presents PNL's review of the utility's proposed maintenance and surveillance (M/S) program. Finally, Section 8 presents PNL's overall conclusions and recommendations regarding the suitability of the two diesel engines to perform their intended function as emergency standby power sources for the Catawba Nuclear Station Unit 1.

47787 **(UNI—2804) Updated project plan: Shippingport Station Decommissioning Project.** Spence, S.T. (UNC Nuclear Industries, Inc., Richland, WA (USA)). Apr 1984. Contract AC06-76RL01857. 45p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE84017250.

Project plans are the primary documentation used by the DOE Decision Authority to identify the Major System Acquisition Process - Key Decision Points. For the Shippingport Station Decommissioning Project (SSDP) the four key decision points are: approve the mission need, project objective, and the initiation of project activity; approve the selection of the SSDP decommissioning mode; approve the initiation of SSDP decommissioning operations; and approve the release of the Shippingport Station site as safe from a radiation standpoint. The purpose of the SSDP is to place the Shippingport Atomic Power Station in a long-term radiologically safe condition following defueling of the reactor, to perform decommissioning in such a manner as to demonstrate to the nuclear industry the application of decommissioning procedures to a large nuclear power plant, and to provide useful planning data for future decommissioning projects.

47788 **DKPOWER: a code for the calculation of decay power energy curies and multigroup beta and gamma spectra using pulse functions.** Wilson, W.B.; England, T.R.; George, D.C.; LaBauve, R.J. (Los Alamos National Laboratory, P.O. Box 1663, Los Alamos, NM 87545). *Transactions of the American Nuclear Society;* 46: 643-645(Jun 1984). (CONF-840614—).

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

2103 Power Reactors, Non-breeding, Graphite Moderated

REFER ALSO TO CITATION(S) 21030047806, 47863, 47880

47789 **(DOE/ET/34034—107) Advanced Gas Cooled Reactor Materials Program. Reducing helium impurity depletion in HTGR materials testing.** Baldwin, D.H. (General Electric Co., Schenectady, NY (USA). Turbine Technology Lab.). Aug 1984. Contract AC03-80ET34034. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE84016619.

Moisture depletion in HTGR materials testing rigs has been empirically studied in the GE High Temperature Reactor Materials Testing Laboratory (HTRMTL). Tests have shown that increased helium flow rates and reduction in reactive (oxidizable) surface area are effective means of reducing depletion. Further, a portion of the depletion has been shown to be due to the presence of free C released by the dissociation of CH_4. This depletion component can be reduced by reducing the helium residence time (increasing the helium flow rate) or by reducing the CH_4 concentration in the test gas. Equipment modifications to reduce depletion have been developed, tested, and in most cases implemented in the HTRMTL to date. These include increasing the Helium Loop No. 1 pumping capacity, conversion of metallic retorts and radiation shields to alumina, isolation of thermocouple probes from the test gas by alumina thermowells, and substitution of non-reactive Mo-TZM for reactive metallic structural components.

47790 **(NP—4901482) Mk. III experiments physical data sheets.** Wells, G.M. (UKAEA Atomic Energy Establishment, Winfrith). 30 Oct 1969. 67p. NTIS (US Sales Only), PC A04/MF A01. File Number DE84901482.

The aim of the experimental programs about to be carried out in the NESTOR and HECTOR reactors is to provide relevant experimental information on AGR III type lattices, in order that the proposed methods of neutronic calculations may be comprehensively tested for such systems. The starting point of such a comparison is clearly a reliable and self-consistent set of physical data for the experiments. Such a set must be used consistently in order that real differences between theory and experiments do not hide behind spurious trends which are due to inconsistencies in data used between these experiments. The data by which the final conclusions are required will not allow a delay in starting comparison calculations until all relevant information is available in its final form. Thus it is inevitable that certain calculations will have to be corrected or repeated as more reliable data is received. It is the aim to minimize this undoubted waste, but it can never be entirely eliminated.

47791 **(NP—4901484) Experimental results from Mk. III AGR Physics Programme, March 1969.** Johnstone, I. (ed.). (UKAEA Atomic Energy Establishment, Winfrith). 6 May 1969. 22p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84901484.

The previous progress report presented results of the first measurements of relative conversion ratio (RCR) and fission ratio (FR) in a central zone of particulate fuel in the NESTOR stack. It was found that spectrum matching provided by the driver fuel region of 2-pin, 3% enriched UO_2 clusters was inadequate, leading to a non-asymptotic spectrum in the measuring region. The driver lattice was therefore changed on 27th February to 1 pin per channel with a reduced channel diameter (5.21 cm.) which improved calculations and showed to be a better match to the III G/C fuel.

47792 **(NP—4901485) Experimental results from Mk.III AGR Physics Programme, January-February 1969.** Johnstone, I.; King, D.C. (UKAEA Atomic Energy Establishment, Winfrith). 26 Mar 1969. 27p. NTIS (US Sales Only), PC A03/MF A01. File Number DE84901485.

Information is presented concerning the Mk 3 AGR stack on NESTOR; details of Mk 3 G/C fuel pins; techniques development for the measurement of relative conversion ratio and fission ratio; and actual measurements of relative conversion ratio and fission ratio.

47793 **(NP—4901642) Experimental results from Mk.III GCR physics, August-September 1969.** Johnstone, I. (ed.). 11 Nov 1969. 23p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84901642.

Reaction rate measurements have been made in two further lattices in the NESTOR stack using a large zone (109 channels) of type B fuel. In AGN 10/B-B/Cu, cylinders of copper poison were inserted into each fuel pin void while in core AGN 11/B-B/C, graphite fillers were used in each void. The NESTOR stack has been rebuilt with vertical channels as a bare exponential stack using source neutrons. Results from six single zone exponential buckling measurements have been reported. Results of the HECTOR measurements of reactivity and reaction rate changes on heating PuO_2/UO_2 pins to 427°C have been reported. To check possible systematic errors in the dissolution and weighing techniques involved in the conversion ratio measurements, RCR determinations on natural UO_2 pellet fuels have been made by three separate methods. All three measurements agreed to within +- 1% in RCR.

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 21050047811, 47839, 47843, 47852, 47863, 47868, 47869, 47953

47794 **(CEA-CONF—7156) Stainless steel-sodium junctions for temperature noise analysis on LWBWR state of art.** Girard, J.P. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France)). May 1983. 7p. (DRNR-P—270; CONF-8305156—2). NTIS (US Sales Only), PC A02/MF A01. File Number DE84751752.

From 16. informal meeting on reactor noise; Budapest, Hungary (18 May 1983).

The ability of sodium to develop a thermoelectric voltage with different metals, among them stainless-steels, is used in the sensor presented in this article. A description of the sensor is first given, then the experimental work performed to understand how the injection works is briefly presented.

47795 **(CEA-CONF—7157) Interpretation of experiments made in ZEBRA CADENZA assemblies with CEA formulary.** D'Angelo, A.; Rimpault, G. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France)). Jun 1983. 59p. (DRNR-P—271; CONF-8306206—1). NTIS (US Sales Only), PC A04/MF A01. File Number DE84751751.

From NEA specialist meeting on the intercomparison of calculations for the pin-plate cell heterogeneity benchmark; Winfrith, UK (21 Jun 1983).

A benchmark exercise on fast critical heterogeneity method assessment has been proposed in the framework of NEACRP. It is based on the analysis of two integral experiments performed by UKAEA on the ZEBRA facility (the CADENZA assemblies): - a plate fuelled core (ZEBRA 22); - a 75% pin fuelled core (ZEBRA 23). The interpretation of these experiments has been done using the current standard CEA methods. We find a relevant (650 pcm) discrepancy between the "k" values of ZEBRA 22 and ZEBRA 23 pin assemblies. We try in this report to find out the origin of this discrepancy. The spatial k-value calculation results and corrections are affected by no more than 150 pcm and are partially correlated. Moreover, this discrepancy does not seem to be explained in terms of homogenous infinite dilute cross section effects. It has been found that most of the discrepancy can be traced back to heterogeneity effects, and mainly to the heterogeneity effects of the metallic fuel plate in the metallic fuel plate in the ZEBRA 22 cell. Finally, the pin core gives, in the CEA analysis, a Keff E-C value well inside the known performance of the adjusted CARNAVAL IV formulaire (i.e. E-C =+ 300 + +500+-200 pcm) for plutonium fuelled cores.

47796 (CONF-840901—11) **Measurements and analysis of control rod worths in large heterogeneous LMFBR cores.** Collins, P.J.; Brumbach, S.B.; Carpenter, S.G. (Argonne National Lab., Idaho Falls, ID (USA); Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). 1984. Contract W-31-109-ENG-38. 22p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84017453.

From ANS topical meeting on reactor physics and shielding; Chicago, IL, USA (17 Sep 1984).

The ZPPR-13 program provides basic physics data for heterogeneous LMFBR cores of 700 MW(e) size. A number of internal blanket variations were studied and measurements of control rod worths were made in each configuration. The cores are sensitive to asymmetric perturbations and have strong interaction effects between control rods. Calculations with ENDF/B-IV data are within about 5% of experimental values but show systematic variations in accuracy of prediction with location in the core.

47797 (CONF-850809—1-Summ.) **Benchmark and physics testing of LIFE-4C. Summary.** Liu, Y.Y. (Argonne National Lab., IL (USA)). Jun 1984. Contract W-31-109-ENG-38. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84016320.

From 8. international conference on structural mechanics in reactor technology; Brussels, Belgium (19 Aug 1985).

LIFE-4C is a steady-state/transient analysis code developed for performance evaluation of carbide [(U,Pu)C and UC] fuel elements in advanced LMFBRs. This paper summarizes selected results obtained during a crucial step in the development of LIFE-4C - benchmark and physics testing.

47798 (LA—10120-PR) **Examination of fast reactor fuels and FBR analytical quality-assurance standards and methods. Progress report, January 1, 1984-March 31, 1984.** Dowler, K.E. (comp.). (Los Alamos National Lab., NM (USA)). Jun 1984. Contract W-7405-ENG-36. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84016983.

This is the 38th quarterly report of the Examination of Fast Breeder Reactor (FBR) Fuels and Analytical Quality-Assurance Standards and Methods at the Los Alamos National Laboratory. Most of the investigations discussed here are continuing. Results and conclusions described may therefore be changed or augmented as the work progresses. Published references to results cited in this report should not be made without obtaining explicit permission to do so from the person in charge of the work.

47799 (NEDM—14103) **Sodium-water reaction products drainability scoping test report.** Anand, R.K.; Reynolds, R.G. (General Electric Co., Sunnyvale, CA (USA). Breeder Reactor Dept.). Apr 1976. Contract AT03-76SF70010. 21p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84017295.

A drainability scoping test was run which demonstrated that a 800°F (427°C) caustic/sodium solution could be quickly drained through a 1-inch pipe and valve at a similar temperature without forming a flow blockage. The solution was formed by injecting 150 grams of high pressure steam into 2 lbs (907 gms) of molten sodium. The sodium/sodium hydroxide phase diagram suggests the draining was easy because sodium hydroxide (molten above 725°F (385°C)) was formed. It was concluded that additional bench tests plus some large rig tests are required to measure the effects for other temperatures and steam injection quantities.

47800 (RCN—219) **Fast reactor programme. Combined second and third quarters 1974 progress report.** Hoekstra, E.K. (comp.). (Stichting Reactor Centrum Nederland, The Hague). Nov 1974. 86p. NTIS (US Sales Only), PC A05/MF A01. File Number DE84901961.

Final evaluation of the central neutron spectra of five STEK cores, determination of the reactivity worths of isotopic samples and development of codes for cross section evaluation are discussed. Results of out-of-pile burst tests on tubes of fuel cladding material exposed to hot sodium are compared with those on tubes of this material in the as-received condition; post-irradiation examination results are given of the fuel pins R54-F27, R63-L07 and R63-L08. Attempts to prepare UC powders of low oxygen content and with a large surface area are reported. Fatigue crack growth rates in DIN 1.4948 stainless steel measured at room temperature and at 500°C are given. A mathematical model of the quantitative decay of an aerosol in an enclosed condensing atmosphere is described. Thermal noise analysis and single and two-phase sodium heat transfer experiments in a 12-rod bundle are described; the fission and Nusselt multipliers and thermal performance for constant pumping power, calculated from the measured heat transfer data of three artificially roughened rods LUCY-110, 111 and 112 held in flowing air, are given.

47801 (RISLEY-Trans—4131) **Cold trap.** Murase, Tatsuo; Sumida, Isao; Kotani, Hiroshi. (Hitachi Ltd., Kawasaki, Kanagawa (Japan). Atomic Energy Research Lab.; UKAEA Risley Nuclear Power Development Establishment). 1981. Translation of Japanese Patent Application No. 1977-150,715. 7p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84901858.

This patent describes a cold trap consisting of a cooling section and a layer of filler material, there being a heat-insulating wall between said cooling section and said filler material layer. In the cold trap in which fluid flows in the vicinity of said cooling section and said filler material layer, said filler material is divided into two layers. In the first layer, the fluid is made to flow from the side of the filler material layer and in the second layer, the fluid is made to flow either from the bottom or the top of the filler material layer.

2106 Power Reactors, Auxiliary, Mobile, Package, And Transportable

REFER ALSO TO CITATION(S) 21060047956

47802 (GESR—2089) **Development of a nuclear thermionic fuel element. Eighteenth quarterly progress report, September 1, 1966-November 30, 1966.** (General Electric Co., Pleasanton, CA (USA). Nuclear Technology Dept.). 1966. 131p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE84017371.

This report describes progress on the development of a thermionic fuel element for nuclear thermionic space power system applications. Objectives are to demonstrate suitable behavior of fuel/clad and insulator materials essential to the thermionic fuel element, to develop internal design details through a combined program of design analysis and converter testing, and to develop the design of thermionic reactor and system through analyses and design calculations.

47803 **Development and test of a space reactor core heat pipe.** Merrigan, M.A.; Runyan, J.E.; Martinez, H.E.; Keddy, E.S. (Los Alamos National Lab., NM). pp 10 of Thermophysics Conference. Montreal, Canada; American Institute of Aeronautics and Astronautics (1983). (CONF-830629—).

From 18. AIAA thermophysics conference; Montreal, Canada (1 Jun 1983).

A heat pipe designed to meet the heat transfer requirements of a 100 kW electrical power space nuclear power system has been developed and tested. General design requirements for the device included an operating temperature of 1500 K with an evaporator radial flux density of 100 w/sq cm. The total heat pipe length of 2 m comprised an evaporator length of 0.3 m, a 1.2 m adiabatic section, and a condenser length of 0.5 m. A four artery design was used with lithium serving as the working fluid. Molybdenum alloys were used for the screen materials and tube shell. Hafnium and zirconium gettering materials were used in connection with a prepurified distilled lithium charge to ensure internal chemical compatability. The pipe was operated successfully at an axial power level greater than 10 kW/sq cm for 100 hrs at 1500 K. The tests demonstrated both the adequacy of the design and the short-term compatibility of the materials. 13 references.

2107 Regulation And Licensing

REFER ALSO TO CITATION(S) 21070047854, 47858

47804 (DSN—646) Development in France of nuclear safety technical regulations and standards used in the licensing procedure. Lebouleux, P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). Apr 1983. 26p. NTIS (US Sales Only), PC A03/MF A01. File Number DE84751753.

Initially, the Commissariat a l'Energie Atomique was the overall structure which encompassed all nuclear activities in France, including those connected with radiological protection and nuclear safety. As other partners appeared, the Authorities have laid down national regulations relative to nuclear installations since 1963. These regulations more particularly provide for the addition of prescriptions with which the applicant must comply to obtain the necessary licenses and the establishment of General Technical Regulations pertaining to nuclear safety. The technical regulation related to nuclear safety in France is made of a set of regulation texts, of a different nature, that define the requirements for the construction, commissioning and operation of nuclear facilities. Simultaneously, the safety authorities (Service Central de Surete des Installations Nucleaires: SCSIN) issue recommendations or guides which are not strictly speaking regulations in the juridical sense; they are called "Regles Fondamentales de Surete" (RFS). The RFS set up and detail the conditions, the respect of which is deemed to be complying with the French regulation practice, for the subject to which they relate. Their purpose is to make known rules judged acceptable by safety authorities, thus making the safety review easier. A RFS, or a letter, can also give the result of the examination of the constructor and operator codes (RCC) by safety authorities.

47805 (NUREG—0540-Vol.6-No.7) Title list of documents made publicly available, July 1-31 1984. Volume 6, No. 7. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Technical Information and Document Control). 1984. 613p. NTIS, PC A99/MF A01 - GPO*. File Number TI85900028.

The Title List of Documents Made Publicly Available is a monthly publication. It contains descriptions of the information received and generated by the US Nuclear Regulatory Commission (NRC). This information includes (1) docketed material associated with civilian nuclear power plants and other uses of radioactive materials and (2) nondocketed material received and generated by NRC pertinent to its role as a regulatory agency. As used here, docketed does not refer to Court dockets; it refers to the system by which NRC maintains its regulatory records. This series of documents is indexed by a Personal Author Index, a Corporate Source Index, and a Report Number Index.

47806 (NUREG—0748-Vol.4-No.7) Operating reactors licensing actions summary. Vol. 4, No. 7. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Resource Management). Aug 1984. 404p. NTIS, PC A18/MF A01 - GPO*. File Number TI84901916.

The operating reactors licensing actions summary is designed to provide the management of the Nuclear Regulatory Commission (NRC) with an overview of licensing actions dealing with operating power and nonpower reactors. These reports utilize data collected from the Division of Licensing in the Office of Nuclear Reactor Regulation and are prepared by the Office of Resource Management. This summary report is published primarily for internal NRC use in managing the Operating Reactors Licensing Actions Program. Its content will change based on NRC management informational requirements.

47807 (NUREG—0750-Vol.19-Index.1) Indexes to Nuclear Regulatory Commission issuances, January-March 1984. Volume 19, Index 1. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Technical Information and Document Control). 1984. 65p. NTIS, PC A04/MF A01 - GPO*. File Number TI84901957.

Digests and indexes for issuances of the Commission, the Atomic Safety and Licensing Appeal Panel, the Atomic Safety and Licensing Board Panel, the Administrative Law Judge, the Directors' Decisions, and the Denials of Petitions of Rulemaking are presented in this document. These digests and indexes are intended to serve as a guide to the issuances. Information elements are displayed in one or more of five separate formats: Case Name Index, Digests and Headers, Legal Citations Index, Subject Index, and Facility Index.

47808 (NUREG—1080-Vol.1) Long-Range Research Plan, FY 1985-FY 1989. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). Sep 1984. 197p. NTIS, PC A09/MF A01 - GPO* $6.00. File Number TI85900050.

The Long-Range Research Plan (LRRP) was prepared by the Office of Nuclear Regulatory Research (RES) to assist the NRC in coordinating its long-range research planning with the short-range budget cycles. The LRRP lays out programmatic approaches for research to help resolve regulatory issues. The plan will be updated annually. This document is divided into the following sections: operating reactor inspection, maintenance, and repair; equipment qualification; seismic research; reactor operations and risk; thermal-hydraulic transients; severe accidents; advanced concepts; radiation protection and health effects; and waste management. The following are also listed as appendices: unresolved safety issues and TMI action plan items, priorities for research program, research program outline, and research utilization report. A glossary of acronyms is included.

47809 (NUREG/CR—3792) Closeout of IE Bulletin 79-11: faulty overcurrent trip device in circuit breakers for engineered safety systems. Foley, W.J.; Dean, R.S.; Hennick, A. (Parameter, Inc., Elm Grove, WI (USA)). Aug 1984. 39p. NTIS, PC A03/MF A01 - GPO* $4.00. File Number TI84901883.

IE Bulletin 79-11 was issued May 22, 1979 as a result of information received in April 1979 from Westinghouse and an NRC licensee relating to the potential failure of a circuit breaker in an engineered safety system of a nuclear power plant. The defect of concern was a small hairline crack in the dashpot end cap of one of the three overcurrent trip devices of a Type DB-75 breaker. The Bulletin was also applicable to Type DB-50 breakers, because they use the same type of dashpot end cap. The defective end cap had been installed in 1973 as a replacement, in compliance with IE Bulletin 73-1. Westinghouse Technical Bulletin NSD-TB-79-02 was issued April 17, 1979 to alert utilities to the potential problem, to provide background information, to recommend review of calibration test data and retesting of erratic breakers, to advise visual examination of end caps for cracks and to call for replacement of cracked end caps. Evaluation of utility responses and NRC/IE inspection reports shows that 114 of the 129 current facilities do not use the affected breakers in safety-related systems. Followup items for the five facilities with open status are proposed. The Bulletin has been closed out for the remaining ten facilities with safety-related Westinghouse DB-50 and DB-75 breakers having dashpots, on the basis of acceptable utility responses and NRC/IE regional inspection reports.

47810 (NUREG/CR—4011) 21/55 data base user's manual. Silver, E.G. (Oak Ridge National Lab., TN (USA)). Sep 1984. Contract AC05-84OR21400. 316p. (ORNL/NSIC—221). NTIS, PC A14/MF A01 - GPO $8.00. File Number TI85002091.

This User's Manual is intended to contain all the information necessary for a prospective user of the Part 21/50.55(e) Data Base (called the 21/55 DB, for short) to sit at a suitable computer terminal and obtain information from the data base, as well as inputting certain types of information designed for input by NRC personnel from remote terminals. The 21/55 DB contains coded information from the reports submitted to NRC by reactor construction licensees and certain suppliers of equipment and components to nuclear facilities licensed to operate, under the requirements of 10 CFR 21 and 10 CFR 50.55(e). The first section presents the general structure and philosophy of the data base. Then the Manual gives step-by-step instructions for logging on, manipulating and selecting data, obtaining desired output, and inputting the information which is designed for insertion from the remote NRC terminals. Last there is a description of the information in the base, its nature, and the codes used.

2108 Economics

REFER ALSO TO CITATION(S) 21080047783, 47989

47811 **(DOE/NE—0051/1) Energy Economic Data Base (EEDB) Program: Phase VI update (1983) report.** (United Engineers and Constructors, Inc., Philadelphia, PA (USA)). Sep 1984. Contract AC05-84OR21400. 286p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE84017631.

This update of the Energy Economic Data Base is the latest in a series of technical and cost studies prepared by United Engineers and Constructors Inc., during the last 18 years. The data base was developed during 1978 and has been updated annually since then. The purpose of the updates has been to reflect the impact of changing regulations and technology on the costs of electric power generating stations. This Phase VI (Sixth) Update report documents the results of the 1983 EEDB Program update effort. The latest effort was a comprehensive update of the technical and capital cost information for the pressurized water reactor, boiling water reactor, and liquid metal fast breeder reactor nuclear power plant data models and for the 800 MWe and 500 MWe high sulfur coal-fired power plant data models. The update provided representative costs for these nuclear and coal-fired power plants for the 1980's. In addition, the updated nuclear power plant data models for the 1980's were modified to provide anticipated costs for nuclear power plants for the 1990's. Consequently, the Phase VI Update has continued to provide important benchmark information through which technical and capital cost trends may be identified that have occurred since January 1, 1978.

47812 **(NUREG/CR—3739) Operator feedback workshop: a technique for obtaining feedback from operations personnel.** McGuire, M.V.; Walsh, M.E.; Boegel, A.J. (Battelle Human Affairs Research Center, Seattle, WA (USA)). Sep 1984. Contract AC06-76RL01830. 225p. (PNL—5124). NTIS, PC A10/MF A01 - GPO $6.50. File Number TI85001607.

This report presents the results of three workshops that were designed, conducted, and assessed for the Nuclear Regulatory Commission. The purposes of the workshops were to (1) examine the effectiveness of workshops as mechanisms for obtaining feedback from utility personnel, including comparison of several different workshop procedures; and (2) obtain feedback for the NRC on topics of interest and concern. The workshops were held in NRC Regions I, II, and III between December 1981 and May 1982. A total of 60 utility personnel attended the workshops and offered comments and suggestions concerning staffing, engineering support in the control room, training tools, training programs, and licensing examinations. Workshop participants and observers evaluated the workshops favorably. Further assessment of the workshop process and content suggested that the workshops were effective in obtaining useful feedback for the NRC.

47813 **(ORNL/TM—9292) User's manual for levelized power generation cost using a microcomputer.** Fuller, L.C. (Oak Ridge National Lab., TN (USA)). Aug 1984. Contract AC05-84OR21400. 135p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE84016516.

Microcomputer programs for the estimation of levelized electrical power generation costs are described. Procedures for light-water reactor plants and coal-fired plants include capital investment cost, operation and maintenance cost, fuel cycle cost, nuclear decommissioning cost, and levelized total generation cost. Programs are written in Pascal and are run on an Apple II Plus microcomputer.

47814 **Emerging trends in nuclear energy.** Weinberg, A.M. (Oak Ridge Associated Univ., TN). *Energy Policy;* 12: No. 3, 247-252(Sep 1984).

Nuclear energy is faltering in many places - especially in the USA: should we write it off as the bubble that burst. The author sees underlying trends that justify a more-optimistic view of nuclear energy's future - the continuing tendency for the electricity intensity of economic activity to rise while the total energy intensity falls; a consistently favorable price trend for electricity compared with energy prices generally - a trend that may become more favourable if his judgment that nuclear plants will turn out to be very long-lived is borne out by events; the substitution of electricity-based processes in industry for older processes; and the development of ultra-safe reactors which will remove once and for all the fears of accidents such as the one that occurred at Three Mile Island.

2109 Process Heat Reactors

REFER ALSO TO CITATION(S) 21090048091

22 NUCLEAR REACTOR TECHNOLOGY

2201 Theory And Calculation

REFER ALSO TO CITATION(S) 22010047782

47815 **Nuclear data of the major actinide fuel materials.** Poenitz, W.P.; Saussure, G. De. (Argonne National Lab., IL). *Progress in Nuclear Energy;* 13: No. 2-3, 129-191(1984).

The effect of nuclear data of the major actinide fuel materials on the design accuracy, economics and safety of nuclear power systems is discussed. Since most of the data are measured relative to measurement standards, in particular the fission cross-section of ^{235}U, data must be examined to ensure that absolute measurements and relative measurements are correctly handled. Nuclear data of fissile materials, fertile materials and minor plutonium isotopes are discussed.

47816 **Applicability of finite elements to transport theory (The code TRIDENT).** Dudziak, D.J. (Los Alamos National Laboratory, NM (USA)); Stepanek, J. (Swiss Federal Institute for Reactor Research, Wuerenlingen). *Newsletter NEA Data Bank;* No. 30, 287-304(Dec 1983). (CONF-8309259—).

From Workshop seminar on finite element multidimensional diffusion codes; Saclay, France (15 Sep 1983).

First, the developments at EIR and Los Alamos of "finite-element" methods with higher order of the polynomial flux approximation in space will be briefly described. Then, the Los Alamos most important features of the finite element two-dimensional transport code TRIDENT-CTR will be summarized, and the current and future cooperative work at EIR and Los Alamos on improvements to TRIDENT-CTR will be discussed. Finally the accuracy of the linear Lagrangian flux approximation in the trigonal finite elements of TRIDENT-CTR will be investigated by calculating the eigenvalue of the LWR pool reactor benchmark problem and comparing the TRIDENT-CTR results to those obtained using the codes TWODANT, TWOTRAN-NODAL, MULTIMEDIUM, SURCU, MARSYAS and TRITON. 27 refs.

2202 Components And Accessories

REFER ALSO TO CITATION(S) 22020047886, 47887, 47888, 47890, 48779

47817 **(CONF-841105—10) Thermal striping downstream of a horizontal elbow under thermally stratified transient flow conditions.** Kuzay, T.M.; Kasza, K.E. (Argonne National Lab., IL (USA)). Jun 1984. Contract W-31-109-ENG-38. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84014687.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; Washington, DC, USA (11 Nov 1984).

A thermally stratified flow produced by a thermal transient passing through a horizontal elbow gives rise to large thermal fluctuations on the inner curvature wall of the downstream piping. These fluctuations were measured in a specially instrumented horizontal pipe and elbow system on a test set-up using water in the

Mixing Components Technology Facility. This study is part of a larger program which is studying the influence of thermal buoyancy on general reactor component performance. This paper discusses the influence of pipe flow generated thermal oscillations on the structured thermal stresses induced in the pipe walls.

47818 **(EGG—2298) Reactor vessel decommissioning project. Final report.** Schoonen, D.H. (EG and G Idaho, Inc., Idaho Falls (USA)). Sep 1984. Contract AC07-76ID01570. 52p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE84017387.

This report describes a reactor vessel decommissioning project; it documents and explains the project objectives, scope, performance results, and sodium removal process. The project was successfully completed in FY-1983, within budget and without significant problems or adverse impact on the environment. Waste generated by the operation included the reactor vessel, drained sodium, and liquid, solid, and gaseous wastes which were significantly less than project estimates. Personnel radiation exposures were minimized, such that the project total was one-half the predicted exposure level. Except for the sodium removed, the material remaining in the reactor vessel is essentially the same as when the vessel arrived for processing.

47819 **(EPRI-NP—3616-Vol.1) Development of a crack arrest toughness data bank for irradiated reactor pressure vessel materials. Volume 1. Program overview. Research Project 1326-1. Final report.** Mager, T.R.; Marschall, C.W. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Nuclear Technology Div.; Battelle Columbus Labs., OH (USA)). Jul 1984. 49p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920547.

Section XI ASME Code flaw evaluation procedure outlines a method for determining the necessity of repairing a crack or defect discovered during an inservice inspection of a nuclear installation. The current procedure for flaw evaluation requires that the effects of high fast-neutron flux on crack-arrest data be taken into consideration. An EPRI sponsored program was carried out by Westinghouse and Battelle's Columbus Laboratories to develop an irradiated crack-arrest-toughness (K/sub Ia/) data bank. The investigation included two A533 Grade B Class 1 steel plates and two submerged arc weldments that are representative of both early and current reactor pressure vessel construction practice. Irradiation to a fluence of 1.5 x 10^{19} n/cm^2 at 290°C produced modest increases in yield strength and in the Charpy-energy transition temperature for the low-copper plate and the low-copper weldment representative of current practice. As was expected, the higher copper materials that are typical of earlier practice showed substantial increases in both properties as a result of irradiation. In none of the steels did the observed shift in the Charpy-energy-versus-temperature curve exceed the shift predicted from the US NRC Regulatory Guide 1.99, which takes into account neutron fluence and the copper and phosphorus contents of the steel. Furthermore, the observed temperature shift in the K/sub Ia/-versus-temperature curve was within plus or minus 20 degrees Celsius of the shift in the Charpy-curve for the low-copper steels, and substantially less than the Charpy-curve shift for the higher copper steels.

47820 **(EPRI-NP—3691) Stress corrosion cracking in steam turbine disks: survey of data collection, reduction, and modeling activities.** Eason, E.D. (Failure Analysis Associates, Palo Alto, CA (USA)). Sep 1984. 116p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920005.

This report reviews the current status of field and laboratory data, data bases, data reduction efforts, and models of various types relevant to the turbine disk stress corrosion cracking problem. The available literature is surveyed and organized in an annotated bibliography by author and in the test and tables by type of data collection, reduction, or modeling effort.

47821 **(NUREG/CR—3766) Testing of nuclear grade lubricants and their effect on A540 B24 and A193 B7 bolting materials.** Czajkowski, C.J. (Brookhaven National Lab., Upton, NY (USA)). Mar 1984. Contract AC02-76CH00016. 83p. (BNL-NUREG—51767). NTIS, PC A05/MF A01; 1 - GPO; GPO Dep. File Number DE84014580.

An increase in the number of bolting failures attributed to lubricant/coolant interaction at nuclear power plants has caused a great deal of concern regarding the more judicious use of lubricants by the nuclear power industry. An investigation was performed on eleven commonly used lubricants by the nuclear power industry. The investigation included EDS analysis of the lubricants, notched-tensile constant extension rate testing of bolting materials with the lubricants, frictional testing of the lubricants and weight loss testing of a bonded solid film lubricant. The report generally concludes that there is a significant amount of variance in the mechanial properties of common bolting materials, that MoS$_2$ can hydrolyze to form H$_2$S at 100°C and cause stress corrosion cracking (SCC) of bolting materials, and that the use of copper-containing lubricants can be potentially detrimental to high strength steels in an aqueous environment. Additionally, the testing of various lubricants disclosed that some lubricants contain potentially detrimental elements (e.g. S, Sb) which can promote SCC of the common bolting materials. One of the most significant findings of this report is the observation that both A193 B7 and A540 B24 bolting materials are susceptible to transgranular stress corrosion cracking in demineralized H$_2$O at 280°C in notched tensile tests. 139 figures.

2203 Fuel Elements

47822 **(GEAP—25163-9) Demonstration of fuel resistant to pellet-cladding interaction: Phase 2. Ninth progress report, January-December 1983.** Rowland, T.C. (comp.). Jun 1984. Contract AC02-77ET34001. 50p. NTIS (US Sales Only), PC A02/MF A01; 1; GPO Dep. File Number DE84017502.

The demonstration is comprised of 144 bundles of Zr-barrier fuel: 44 of the crystal bar type and 100 with liners of low-oxygen sponge zirconium. These demonstraion barrier fuel bundles are now in operation in quad Cities-2. The first demonstration power ramp on 16 of these bundles was successfully completed in March 1983. The four barrier lead test assemblies (LTA's) continued irradiation at Quad Cities-1, achieving a burnup of 29.0 MWd/kg U. Repeat ramp tests of Zr-barrier fuel rods were successfully completed. Four power reactor incubated Zr-barrier fuel rods which had survived high power (~ 59 kW/m) ramp tests in the R-2 Test Reactor in Studsvik were exposed for an additional 5 MWd/kg U at moderate power (<33 kW/m) and then subjected to another series of high power (52.5 kW/m) ramp tests. This was followed by another moderate power exposure interval of 5 MWd/kg U and another series of high power (52.5 kW/m) ramp tests. All of the barrier fuel rods survived these repeated ramp tests. Eleven test fuel rods were ramp tested: ten Zr-barrier rods and one reference rod. The reference rod failed at a power level consistent with previous results. Four of the Zr-barrier fuel rods failed following large power increases at a very fast rate to high linear power levels. The Zr-barrier fuel continues to exhibit convincingly better resistance to PCI failure than reference fuel.

2204 Control Systems

47823 **(EPRI-NP—3659) Human factors guide for nuclear power plant control room development. Final report.** Kinkade, R.G.; Anderson, J. (eds.). Aug 1984. 367p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920046.

This document provides a framework for systematically applying human factors principles and criteria throughout the development of a nuclear power plant control room. It presents guidelines for conducting human factors planning, analysis, design, and evaluation efforts. The document contains seven chapters. Chapter 1 identifies relationships between plant development phases and human factors applications, and presents step-by-step guidelines for structuring a human factors program plan. Chapter 2 presents a recommended approach to describing and analyzing plant functions and systems as well as operator tasks. Chapter 3 provides guidance for control room layout, moderation of environmental conditions, and provisions for habitability. Chapter 4 provides recommendations for defining instrument types, arranging them on available panel surfaces, and establishing labeling, demarcation, and coding conventions. Chapter 5 addresses alarm and annunciator system design specifications and recommends ways to establish a coherent, consistent rationale for alerting and informing personnel about deviant plant conditions requiring operator action. Chapter 6 describes preferred display and control instrument design features that are compatible with personnel expectancies and reflect accepted human factors principles and criteria. Chapter 7 provides guidelines for supporting the design of an integrated communications system. A checklist summarizing the principles and criteria addressed is provided for each chapter. In addition, very basic information about human capabilities is briefly presented in an appendix. A reference list, a glossary of terms, and an index are also provided.

47824 (INIS-mf—9038, pp 143-148) **Operating diagnostics system of WWER 440 nuclear unit.** Drab, F.; Holy, J. (Skoda, Plzen (Czechoslovakia). Zavod Energeticke Strojirenstvi). 1982. (In Czech). NTIS (US Sales Only), PC A02/MF A01. File Number TI84780617. (CONF-8206259—Vol.2).

From Autos 82 - Automation in engineering meeting; Plzen, Czechoslovakia (15 Jun 1982).

The system is divided into two subsystems: the diagnostics of the primary circuit which includes the in-core diagnostics and the diagnostic assembly, and the diagnostics of the control system. The system is designed as an open system; it may be adapted to the requirements proceeding from the projects of the individual nuclear units and to the demands placed by the operator. Practically all sensors of the primary circuit diagnostics are placed inside a sealed zone. The evaluating and control sections use the CAMAC modular system. The system of control consists of a separate computer measuring system which allows for communication between the operator in the unit control room and the operating diagnostics system.

2205 Environmental Aspects

REFER ALSO TO CITATION(S) 22050047851, 47861, 47943, 48518

47825 **(NUREG/CR—3513) Mechanical reliability evaluation of alternate motors for use in a radioiodine air sampler.** Bird, S.K.; Huchton, R.L.; Motes, B.G. (Westinghouse Idaho Nuclear Co., Inc., Idaho Falls (USA)). Mar 1984. Contract AC07-84ID12435. 43p. (WINCO—1006). NTIS, PC A03/MF A01 - GPO. File Number TI84017460.

Detailed mechanical reliability studies of two alternate motors identified for use in the BNL Air Sampler wer conducted. The two motor types were obtained from Minnesota Electric Technology, Incorporated (MET) and TCS Industries (TCSI). Planned testing included evaluation of motor lifetimes and motor operability under different conditions of temperature, relative humidity, simulated rainfall, and dusty air. The TCSI motors were not lifetime tested due to their poor performance during the temperature/relative humidity tests. While operation on alternating current was satisfactory, on direct current only one of five TCSI motors completed all environmental testing. The MET motors had average lifetimes of 47 hours, 97 hours, and 188 hours, respectively, and exhibited satisfactory operation under all environmental test conditions. Therefore, the MET motor appears to be the better candidate motor for use in the BNL Air Sampler. However, because of the relatively high cost of purchasing and incorporating the MET motor into the BNL Air Sampler System, it is recommended that commercial air sampler systems be evaluated for use instead of the BNL system.

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 22060047785, 47793, 47795, 47796, 47882, 48167

47826 **(AD-A—141791/4) Recent re-measurement of neutron and gamma-ray spectra 1080 meters from the APRD (Army Pulse Radiation Division) critical facility.** Robitaille, H.A.; Hoffarth, B.E. (Defence Research Establishment, Ottawa, Ontario (Canada)). Jan 1984. 123p. (DREO—877). NTIS, PC A06/MF A01.

Abstract in French.

Previously reported measurements of long-range air-transported neutron and gamma-ray spectra from the fast-critical facility at the US Army Aberdeen Proving Ground have been supplemented recently at the 1080-meter position. The results of these determinations are presented herein and compared to several recent calculations from other research establishments. In addition, a summary of all dosimetric measurements obtained in the period 1979-1982 are appended, as are new determinations of APRD soil composition. Integral quantities such as neutron and gamma-ray kermas are very well predicted by the latest calculations, however there still exist significant spectral differences. At short ranges calculated neutron spectra are somewhat softer than experimental measurements, but at the farthest range of 1080 meters agreement is surprisingly good. Gamma-ray spectra remain well-calculated at all ranges.

47827 **(CEA-CONF—6824) Comparison calculations-measurements of the fluxes and powers.** Person, J.L.; Bouvard, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Sep 1983. 38p. (In French). (CONF-8309186—5). NTIS (US Sales Only), PC A03/MF A01. File Number DE84751745.

From 49. meeting of the French working group on dosimetry; Grenoble, France (21 Sep 1983).

To established a power map of the ISIS reactor core, the IN.96 programmable analyzer has been used as measuring center, processing unit and even editing unit to make easier the exploitation of the very numerous experimental data. First, the four miniature fission chambers have been calibrated. Then, the method followed to establish the flux distribution in the reactor core is given. A comparison between the measured and the calculated fluxes is made; the calculated ones have been calculated with computed codes (APOLLO and DAIXY); the cross sections used for these calculations are given. Then, a comparison of the measured values and the calculated values of the power map is presented. A map of the hot spot factors has been made, establishing simultaneously the map of the equivalent spot obtained with DAIXY.

47828 (INIS-mf—9038, pp 149-158) **Dynamics experiments on LR-0 reactor.** Drab, F.; Holy, J. (Skoda, Plzen (Czechoslovakia). Zavod Energeticke Strojirenstvi); Karpeta, C. (Vyzkumny Ustav Energeticky, Bechovice (Czechoslovakia)). 1982. (In Czech). NTIS (US Sales Only), PC A02/MF A01. File Number TI84780617. (CONF-8206259—Vol.2).

From Autos 82 - Automation in engineering meeting; Plzen, Czechoslovakia (15 Jun 1982).

The mathematical model of spatial dynamics designed for the solution of problems of reactor control must be able to conduct a synthesis and analysis of the control system of entire reactor power and of the spatial distribution of the core power, the interpretation of information from in-core measurements and computations of control processes in different normal and abnormal modes. The LR-0 reactor was used for experimental tests of that part of the model which is related to kinetics. In order to map the nonsteady state distribution of neutron flux density a multichannel system of in-core instrumentation was designed. The system of in-core measurements has 33 channels, each channel consists of a miniature neutron detector and related electronic circuits. Modular NR 1000 equipment units are used, the evaluation system is based on the CAMAC system.

2207 Plutonium And Isotope Production Reactors

47829 **(HW—76661) Design bases - N-reactor conversion to Phase II dual purpose operation.** Kosmata, H.R.; Condotta, D.L. (General Electric Co., Richland, WA (USA). Hanford Atomic Products Operation). 16 Apr 1963. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84017368.

Declassified 8 January 1973.

The design of power generating facilities for the N-reactor requires design bases in addition of those already in existence. These bases establish the N-reactor performance data to be used for conversion design and the requirements for the design of the reactor plant modifications and the generating plant insofar as they affect the operability and safety of the reactor plant. Primarily these requirements center about the steam conditions which may be expected and the interrelations between the operation of the reactor and the power generating facilities. The items subsequently stated operational requirements and equipment performance which may be used as bases for Phase II design. Phase III expected steam conditions as a function of reactor power level are stated so that they too may be used as needed for Phase II design.

2208 Propulsion Reactors

47830 **(GV—58-27-30) Design and performance of secondary cooling systems for the XMA-1 power plant for subsonic applications.** Peterson, J.A.; Page, D.M. 21 Jul 1958. 69p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE84012619.

In this report, the best designs of secondary cooling systems are evolved, one for each of three modes of power plant operation, for the subsonic application of the XMA-1 power plant. The performance of these systems was evaluated and the operation of the variable geometry features and control system requirements are described.

47831 **(LAMS—1870-Del.) Feasibility of nuclear-powered long range ballistic missiles.** Aamodt, R.L.; Bell, G.I.; Bendt, P.J.; Bussard, R.W.; Durham, F.P.; Froman, D.K.; Gittings, H.T.; Hammond, R.P.; Kolsky, H.G.; Longmire, C.L. (Los Alamos Scientific Lab., NM (USA)). Mar 1955. Contract W-7405-ENG-36. 106p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE84016834.

A combination of a chemical booster and a nuclear rocket is proposed to accomplish the Atlas and/or more exacting missions. It is estimated that by using current chemical boosting techniques nuclear rockets can be developed of relatively small weight capable of delivering large pay loads to distances of 5500 nautical miles and beyond.

47832 **(LAMS—2893) LASL Rover Program. Monthly status report, March 20, 1963.** (Los Alamos Scientific Lab., NM (USA)). 26 Apr 1963. Contract W-7405-ENG-36. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84016874.

This document reports on: Kiwi-B(1B, 2A-CF, 4A, 4A-CF, 4B-CF, 4D, 5, 6A), NRDS activities, graphite fuel element development, metal fuel element development, materials and fabrication, and nuclear flight safety. (DLC)

2209 Reactor Safety

REFER ALSO TO CITATION(S) 22090047543, 47808, 47814, 48272

47833 **(AD-A—141490/3) Stochastic models for common failures of components. Technical summary report.** Harris, B. (Wisconsin Univ., Madison (USA). Mathematics Research Center). Mar 1984. 34p. (MRC-TSR—2659). NTIS, PC A03/MF A01.

Much of the literature dealing with system failures assumes that individual subsystems or components are stochastically independent. In this report, some models that have been used for analyzing dependent failures are examined and one new time dependent stress-strength(loading) model is proposed. These models are of particular interest in the probabilistic risk assessment of nuclear reactors.

47834 **(AD-P—003375/3) Staffing and shift hours: performance considerations.** Price, H.E.; Bauman, M.B. (Bio Technology, Inc., Falls Church, VA (USA)). Jun 1981. 34p. NTIS, PC A03/MF A01.

This article is from 'Proceedings of the Symposium on the Role of Behavioral Science on Physical Security (6th Annual), Held at Springfield, Virginia, 3-4 June 1981', AD-A141426, p111-145.

An important consideration in site surveillance is whether trade-offs in staffing configurations could be used to compensate for less than desired numbers of personnel at nuclear sites. This is a report of a literature search to determine the state of knowledge about the effects on performance with staff manning and shift duration as variables. While this literature search was done for nuclear power plant control room operators, the findings may have broader applicability to guard force staffing and shift policies. The alternatives examined were working longer shifts, reducing the number of qualified personnel required on any shift, and using individuals with less training and experience. The results were inconclusive, but the least desirable alternative is using less qualified personnel. LOng shift hours probably result in some performance decrement, as compared to 8-hour shifts, but the extent of the decrement is uncertain. A reduction in manning is the favored alternative, but this holds only for normal operations.

47835 **(BNL-NUREG—29860) TRAC-PD2 and RELAP5/MOD1 predictions of heated rod bundle experiments.** Neymotin, L. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 7p. (CONF-811103—28). NTIS, PC A02/MF A01 - GPO. File Number TI84017654.

From ANS winter meeting; San Francisco, CA, USA (29 Nov 1981).

Neither code adequately predicts the subcooled boiling region of the flow: In [D-PD2, this is due to an inadequacy in the subcooled boiling model, in RELAP5/MOD1, this is due to a lack of the corresponding model. RELAP5/MOD1 predicts bulk boiling at conditions closer to equilibrium than TRAC-PD2. The codes use slighly different vertical flow region maps and correlations for interfacial friction; TRAC-PD2 predictions of the void distribution were in better agreement with the test data.

47836 **(BNL-NUREG—34701) Plant analyzer for high-speed interactive simulation of BWR power plant transients.** Cheng, H.S.; Lekach, S.V.; Mallen, A.N.; Wulff, W.; Cerbone, R.J. (Brookhaven National Lab., Upton, NY (USA)). Apr 1984. Contract AC02-76CH00016. 20p. (CONF-841080—1). NTIS, PC A02/MF A01 - GPO; GPO Dep. File Number TI84012909.

From Joint ANS meeting; Taipei, Taiwan (1 Oct 1984).

A combination of advanced modeling techniques and modern, special-purpose peripheral minicomputer technology is presented which affords realistic predictions of plant transient and severe off-normal events in LWR power plants through on-line simulations at a speed ten times faster than actual process speeds. Results are shown for a BWR plant simulation. The mathematical models account for nonequilibrium, nonhomogeneous two-phase flow effects in the coolant, for acoustical effects in the steam line and for the dynamics of the recirculation loop and feedwater train. Point kinetics incorporate reactivity feedback due to void fraction, fuel temperature, coolant temperature, and boron concentration. Control systems and trip logic are simulated for the nuclear steam supply system. The AD10 of Applied Dynamics International is the special-purpose peripheral processor. It is specifically designed for high-speed digital system simulation, accommodates hardware (instrumentation) in the input/output loop, and operates interactively on-line, like an analog computer. Results are shown to demonstrate computing capacity, accuracy, and speed. Simulation speeds have been achieved which are orders of magnitude faster than those of a CDC-7600 mainframe computer or ten times faster than real-time speed.

47837 **(CONF-840816—15) Mixed convection and high-pressure low-flow steam cooling data from a 64-rod bundle.** Sozer, A. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84016608.

From 22. national heat transfer conference; Niagara Falls, NY, USA (5 Aug 1984).

Heat transfer data were obtained from low flow steam cooling experiments in a partially uncovered 64-rod bundle. These tests indicated that free convection effects were superimposed on the laminar and turbulent forced convection heat transfer. This paper describes the influence of buoyancy on laminar and turbulent forced convection heat transfer coefficients. Mechanisms due to buoyancy which alter the local heat transfer are summarized. Criteria indicating the importance of buoyancy on laminar and turbulent upflow in a vertical pipe were developed and compared to other criteria found in the literature. These criteria were used to determine the steam cooling data with significant buoyancy influence. Data with buoyancy influence were compared to mixed convection correlations and to a numerical study for rod bundles.

47838 (CONF-840914—13) Results and analysis of reactor-material experiments on ex-vessel corium quench and dispersal. Spencer, B.W.; McUmber, L.M.; Sienicki, J.J.; Squarer, D. (Argonne National Lab., IL (USA); Electric Power Research Inst., Palo Alto, CA (USA)). 1984. Contract W-31-109-ENG-38. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84017491.

From International meeting on thermal nuclear reactor safety; Karlsruhe, F.R. Germany (10 Sep 1984).

Results of reactor-material experiments and related analysis are described in which molten corium is injected into a mock-up of the reactor cavity region of a PWR. The experiments address ex-vessel interactions such as steam generation (for those cases in which water is present), water and corium dispersal from the cavity, hydrogen generation, direct atmosphere heating by dispersed corium, and debris characterization. Test results indicate efficiencies of steam generation by corium quench ranging up to 65%. Corium sweepout of up to 62% of the injected material was found for those conditions in which steam generation flowrate was augmented by vessel blowdown. The dispersed corium caused very little direct heating of the atmosphere for the configuration employing a trap at the exit of the cavity-to-containment pathway. Corium sweepout phenomena were modeled for high-pressure blowdown conditions, and the results applied to the full-size reactor system predict essentially complete sweepout of corium from the reactor cavity.

47839 (CONF-841115—1) Dynamic simulator for nuclear power plants (DSNP): development, verification, and expansion of modules. Larson, H.A.; Dean, E.M.; Koenig, J.F.; Gale, J.G.; Lehto, W.K. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84009199.

From International conference on power plant simulation; Mexico City, Mexico (19 Nov 1984).

The DSNP Simulation Language facilitates whole reactor plant simulation and design. Verification includes DSNP dynamic modeling of Experimental Breeder Reactor No. 2 (EBR-II) plant experiments as well as comparisons with verified simulation programs. Great flexibility is allowed in expanding the DSNP language and accommodate other computer languages. The component modules of DSNP, contained in libraries, are continually updated with new, improved, and verified modules. The modules are used to simulate the dynamic response of LMFBR reactor systems to upset and transient conditions, with special emphasis on investigations of inherent shutdown mechanisms.

47840 (CONF-841121—1) Gas fluidization of solids in a stationary liquid. Gabor, J.D.; Cassulo, J.C.; Fountain, D.; Bingle, J.D. (Argonne National Lab., IL (USA)). Nov 1984. Contract W-31-109-ENG-38. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE84006551.

From AIChE annual meeting; San Francisco, CA, USA (25 Nov 1984).

Critical gas flow rates were measured for fluidizing initially static beds of particles and for settling of fluidized beds in a stationary pool of liquid. Experiments were conducted with beds of glass, nickel and UO_2 particles ranging in size from 11 to 548 μm in pools of water, ethanol, Freon-113 and water-glycerine solutions. Beds of particles smaller than 328 μm were fluidized by a mechanism of individual particles being carried off of walls of channels in the bed, and beds of particles larger than 328 μm slugged before breaking up to a fluidized state. The data were empirically correlated.

47841 (CONF-8305160—Summs.) Seismic risk and heavy industrial facilities conference: proceedings. (Lawrence Livermore National Lab., CA (USA)). 1983. Contract W-7405-ENG-48. 135p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE84004249.

From Seismic risk and heavy industrial facilities conference; San Francisco, CA, USA (11 May 1983).

Summaries of over 50 papers related to seismic risk analysis were presented. The papers cover areas such as seismic input description, response of components and structures, assessment of risk and reliability including human factors, and results of integrated studies. Papers have been individually abstracted for the Energy Data Base.

47842 (DOE/NE/32104—T1) Assessment of Mobile Accident Response Capability. Mar 1983. Contract AC01-82NE32104. 114p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE84010860.

This report presents the results of a DOE-sponsored assessment of nuclear accident response resources. It identifies the mobile resources that could be required to respond to different types of nuclear accidents including major ones like TMI-2, identifies the resources currently available and makes recommendations for the design and construction of additional mobile accident response resources to supplement those already in existence. This project is referred to as the Mobile Accident Response Capability (MARC) program.

47843 (DOE/OR/00033—T73) Analysis of large two phase uranium dioxide bubble behavior in water and sodium pools. Webb, R.L. (Virginia Univ., Charlottesville (USA). School of Engineering and Applied Science). May 1984. Contract AC05-76OR00033. 271p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE84017139.

An understanding of the behavior of large, two-phase UO_2 bubbles is important in assessing the consequences of a hypothetical core disruptive accident in a fast reactor. The UVABUBL II computer program was written to study the dynamics and heat and mass transfer in large UO_2 bubbles, and the code was used to analyze data from the underwater and undersodium FAST experiments conducted at Oak Ridge National Laboratory in which the behavior of UO_2 bubbles under a wide variety of conditions was examined. Significant understanding of the phenomena that govern UO_2 bubble behavior in both water and sodium was obtained by matching calculations of pressure, bubble size, and bubble growth and collapse rate to the experimental data. Heat and mass transfer included radiative heat losses and coolant entrainment. Larger heat transfer rates were calculated for the water tests with significant surface vaporization occurring. Because of the high thermal conductivity of sodium, no surface vaporization was calculated for the sodium tests. Entrainment was not found to be necessary for either the water or sodium tests, but calculations that included entrainment implied that it may be occurring. 38 references.

47844 (EGG-M—08084) Liquid-solid contact measurements using a surface thermocouple temperature probe in atmospheric pool boiling water. Lee, L.Y.W.; Chen, J.C.; Nelson, R.A. (Lehigh Univ., Bethlehem, PA (USA). Inst. of Thermo-Fluid Engineering and Science; EG and G Idaho, Inc., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 11p. (CONF-840816—17). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84017238.

From 22. national heat transfer conference; Niagara Falls, NY, USA (5 Aug 1984).

Objective was to apply the technique of using a microthermocouple flush-mounted at the boiling surface for the measurement of the local-surface-temperature history in film and transition boiling on high temperature surfaces. From this measurement direct liquid-solid contact in film and transition boiling regimes was observed. In pool boiling of saturated, distilled, deionized water on an aluminum-coated copper surface, the time-averaged, local-liquid-contact fraction increased with decreasing surface superheat. Average contact duration increased monotonically with decreasing surface superheat, while frequency of liquid contact reached a maximum of ~ 50 contacts/s at a surface superheat of ~ 100 K and decreased gradually to 30 contacts/s near the critical heat flux. The liquid-solid contact duration distribution was dominated by short contacts < 4 ms for high surface superheats and shifted to long contacts > 4 ms at low surface superheats, passing through a relatively flat contact duration distribution at about 80°K. Results of this paper indicate that liquid-solid contacts may be the dominant mechanism for energy transfer in the transition boiling process.

47845 (EGG-M—23283) **Comparison of heat and mass transfer correlations with forced convective nonequilibrium post-CHF experimental data.** Condie, K.G.; Gottula, R.C.; Nelson, R.A.; Neti, S.; Chen, J.C.; Sundaram, R.K. (EG and G Idaho, Inc., Idaho Falls (USA); Lehigh Univ., Bethlehem, PA (USA); Yankee Atomic Electric Co., Framingham, MA (USA)). 1984. Contract AC07-76ID01570. 9p. (CONF-840816—19). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84017233.

From 22. national heat transfer conference; Niagara Falls, NY, USA (5 Aug 1984).

Forced convective, nonequilibrium post-CHF heat transfer data (766 points) have been obtained at high pressure and low mass flux ranges not previously tested. The data are unique in that the superheated vapor temperature was measured at multiple elevations allowing the direct calculation of vapor generation rates. The data are useful for verification or development of nonequilibrium heat and mass transfer models. Current film boiling heat transfer correlations do not predict the data well. The Dougall-Rohsenow equilibrium correlation is the only one investigated that reasonably predicts the measured wall heat fluxes. Current vapor generation rate models do not adequately predict the measured vapor generation rates.

47846 (EPRI-NP—3573-SR) **Robinson 2 reactor vessel: pressurized thermal shock analysis for a small-break LOCA.** Marston, T.; Griesbach, T.; Chao, J.; Chexal, B.; Norris, D.; Nickell, B.; Layman, B. (Electric Power Research Inst., Palo Alto, CA (USA)). Aug 1984. 138p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920013.

A best-estimate Pressurized Thermal Shock (PTS) analysis was performed for a three-inch diameter hot-leg small-break loss-of-coolant accident for the Robinson 2 plant. This plant specific analysis was performed using EPRI's linked set of codes for PTS analysis. The analysis shows that with the H.B. Robinson 2 reactor pressure vessel, a hot-leg small-break loss-of-coolant accident does not pose a significant health or safety concern to the public for at least 40 years of operation.

47847 (EPRI-NP—3613-Vol.1) **Application of probabilistic and decision analysis methods to structural mechanics and materials sciences problems. Volume 1. Planning document.** Garrick, B.J.; Tagart, S.W. Jr. (eds.). (Strategic Decisions Group, Menlo Park, CA (USA)). Aug 1984. 60p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920044.

Volume I presents an overview of the EPRI structural reliability research program. First, perspectives on the probabilistic treatment of uncertainty are presented. A brief explanation is given of why decision analysis methods are part of EPRI's structural reliability project, and how the use of such methods to handle uncertainty can improve decision-making in this area. A more detailed discussion of one approach for dealing with uncertainty about event probabilities is also presented. Next, review of probabilistic risk analysis is presented. This review includes a brief history of its development and application, an overview of the methodology involved, the role of structural reliability assessment in providing input to PRAs, and the treatment of uncertainties in that input. A brief discussion of the relationship between PRA and safety goals is also included.

47848 (EPRI-NP—3613-Vol.2) **Application of probabilistic and decision analysis methods to structural mechanics and materials sciences problems. Volume 2. Resource document.** Garrick, B.J.; Tagart, S.W. Jr. (eds.). (Strategic Decisions Group, Menlo Park, CA (USA)). Aug 1984. 117p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920043.

This volume presents background resource material on the field of structural reliability assessment and its relationship to the discipline of probabilistic risk analysis and decision analysis. First, general background material is presented on the field of structural reliability assessment. Next, some sample applications of probabilistic and decision analysis methods are presented. A hypothetical example illustrates how a probabilistic approach could be used in structural design, and a brief description is given of how the results of structural reliability analyses can be used as input to a PRA. A case study is described on the use of decision analysis to select strategies for dealing with intergranular stress corrosion cracking. The use of decision analysis to evaluate the merits of different possible research tasks is also discussed. A discussion of decision analysis is then presented. Finally, the document presents a discussion of open issues in the area of structural reliability.

47849 (EPRI-NP—3677) **Comparison of the calculation of HDR RPV-1 blowdown loads for test V32 with the experimental data.** Mortensen, G.A.; Santee, G.E. Jr.; Chang, F.H.; Brockett, G.F.; Gross, M.; Belytschko, T. (Intermountain Technologies, Inc., Idaho Falls, ID (USA); Science Applications, Inc., San Leandro, CA (USA); Northwestern Univ., Evanston, IL (USA). Dept. of Civil Engineering). Aug 1984. 322p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920029.

Using the three-dimensional STEALTH/WHAMSE computer program, researchers calculated blowdown loads for HDR test V32 on a large-scale reactor vessel. The calculation, which compared well with test results, provides a good example of the predictive capability of the computer program. The program can be applied to nuclear and nonnuclear fluid-structure interaction problems.

47850 (ETEC-TDR—84-6) **Containment purge and vent valve program. Final report.** Archbold, P. (Energy Technology Engineering Center, Canoga Park, CA (USA)). 12 Jul 1984. Contract AC03-76SF00700. 72p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85001933.

This report describes the Test Piping System and Instrumentation used to determine the forces acting against the actuator when closing a butterfly valve against flow. Locations of the test instrumentation are shown and photos of the installation are included. The techniques for determining bearing and packing resistance, seating forces and fluid dynamic forces are described. Various problems encountered and corrective actions taken are discussed. Typical plots are included to illustrate the results obtained. Complete sets of data for each valve program were transmitted to EG and G, Idaho for detailed analysis.

47851 (GEND-INF—055) **Solidification of EPICOR-II resin waste forms.** Neilson, R.M. Jr.; McConnell, J.W. Jr. (EG and G Idaho, Inc., Idaho Falls (USA)). Aug 1984. Contract AC07-76ID01570. 40p. NTIS, PC A03/MF A01; GPO Dep. File Number DE84017410.

One goal of the EPICOR-II Research and Disposition Program is to investigate methods of immobilizing ion exchange resin wastes by solidification. Formulations were developed for the solidification of EPICOR-II prefilter wastes from Three Mile Island Unit-2 using Portland type I-II cement and vinyl ester-styrene. In developing formulations, ion exchange resins and zeolite simulating those in EPICOR-II prefilters were used. Once suitable formulations were defined, radioactive wastes from EPICOR-II prefilters PF-7 (organic ion exchange resins) and PF-24 (organic ion exchange resins with zeolite) were solidified. A total of 267 radioactive waste form specimens were prepared in hot cell solidification operations. That total includes 136 Portland cement specimens (72 incorporating prefilter PF-7 waste and 64 with prefilter PF-24 waste) and 131 vinyl ester-styrene specimens (71 incorporating prefilter PF-7 waste and 60 with prefilter PF-24 waste). The methodologies used and products produced are described and evaluated in this report.

47852 (GRS—56) **Risk-oriented analysis of the SNR-300.** (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Apr 1984. 94p. (In German). Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.).

The systems analysis comprises accident sequences, the release of radionuclides, the spent fuel storage, external events and expected frequencies of accident sequences and consequences. A comparison of the risk of SNR-300 and PWR is carried out and special problems are discussed.

47853 (GRS-A—635) TREBIL - a computer program for fault tree preparing. Lubig, G.; Gueldner, W. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Garching (Germany, F.R.)). Jul 1981. 56p. (In German). Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Garching (Germany, F.R.).

This report describes the function of the FORTRAN computer code for fault tree preparing named TREBIL. The program function is explained in detail so that later modifications are facilitated. By means of many examples the applications of the program are illustrated for the users, who can choose a fault tree preparing for the follow up calculating programs CRESSEX, STREUSL, MINICU or the plotting program TIMBER respectively TIMBRATE (TIMBER WITH RATES).

47854 (GRS-A—639) Computer code package RALLY for probabilistic safety assessment of large technical systems. Gueldner, W.; Polke, H.; Spindler, H.; Zipf, G. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Garching (Germany, F.R.)). Sep 1981. 39p. (In German). Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Garching (Germany, F.R.).

This report describes the program system RALLY to compute the reliability of large and intermeshed technical systems. In addition to a short explanation of the different programs, the possible applications of the program system RALLY are demonstrated. Finally, the most important studies carried out so far on RALLY are discussed.

47855 (GRS-A—844) Post-test analysis of the LOBI test A1-70 with the computer program DRUFAN-02. Ringer, F.J. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Garching (Germany, F.R.)). Jul 1983. 107p. (In German). Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Garching (Germany, F.R.).

The GRS is engaged in supporting the test project RS 109 (LOBI = Loop Blowdown Investigation) of BMFT with analyses of physical phenomena and for verification of the blowdown code DRUFAN. Test objective was the system behaviour of the LOBI facility during a LOCA with break location in the pump seal. A first phenomenological comparison with the reference tests indicated that the pump seal break showed much more similarity with the hot leg break than with the cold leg break. Within the framework of BMFT contract RS 475 the GRS performed a prediction and post-test-analysis for test A1-70. Both calculations were done with DRUFAN-02. The results of the prediction could be improved by using a more detailled nodalization and the actual instead of the specified initial and boundary conditions.

47856 (GRS-F—122) Surveys of research projects concerning reactor safety, financed by the Bundesminister des Innern. Progress report. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Jun 1983. 119p. (In German). Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.).

The FRG's Home Office finances studies, expertises and investigations in the field of reactor safety. The results of such work are meant to clarify questions left open concerning the execution of licensing procedures for nuclear facilities. The GRS (reactor safety company) regularly provides information on the state of such studies, on the authority of the Home Office. Annually published GRS-F reports on the progress provide information for the Federal and regional authorities concerned as well as for the reactor safety commission (RSK). Each progress report is a collection of individual reports, categorized by subject matter. They are a documentation of the contractors' progress, rendered by themselves on standardized forms, published, for the sake of general information on progress made in investigations concerning reactor safety, by the project attendance department of the GRS. The individual reports have serial numbers. Each report includes particulars of the objective, work carried out, results obtained and plans for project continuation.

47857 (INIS-mf—9040, pp 130-131) **United States Department of Energy surplus facilities management program.** Nemic, J.F. (UNC Nuclear Industries, Inc., Richland, WA (USA)); White, J.D. (Department of Energy, Richland, WA (USA). Richland Operations Office). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

47858 (NUREG—0787-Suppl.7) Safety evaluation report related to the operation of Waterford Steam Electric Station, Unit No. 3 (Docket No. 50-382). Supplement No. 7. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Sep 1984. 584p. NTIS, PC A25/MF A01 - GPO* $11.00. File Number TI85900030.

Supplement 7 to the Safety Evaluation Report for Louisiana Power and Light's application for a license to operate Waterford Steam Electric Station, Unit 3 (Docket No. 50-382), located in St. Charles Parish, Louisiana, has been jointly prepared by the Office of Nuclear Reactor Regulation and the Region IV Office of the US Nuclear Regulatory Commission. This supplement provides the results to date of the staff's evaluation of approximately 350 allegations and concerns of poor construction practices at the Waterford 3 facility.

47859 (NUREG—0926-Rev.1) Technical specifications for Grand Gulf Nuclear Station, Unit 1 (Docket No. 50-416). Appendix A to License No. NPF-13. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Aug 1984. 541p. NTIS, PC A23/MF A01 - GPO* $10.00. File Number TI85900070.

The Grand Gulf Nuclear Station, Unit 1 Technical Specifications were prepared by the US Nuclear Regulatory Commission to set forth the limits, operating conditions and other requirements applicable to a nuclear facility as set forth in Section 50.36 of 10 CFR part 50 for the protection of the health and safety of the public.

47860 (NUREG—0978-F) Mark III LOCA-related hydrodynamic load definition. Generic technical activity B-10. Final report. Fields, M.B.; Kudrick, J.A. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Aug 1984. 100p. NTIS, PC A05/MF A01 - GPO* $4.75. File Number TI85900064.

This report, prepared by the staff of the Office of Nuclear Reactor Regulation and its consultants at the Brookhaven National Laboratory, provides a discussion of LOCA-related suppression pool hydrodynamic loads in boiling water reactor (BWR) facilities with the Mark III pressure-suppression containment design. Its issuance completes NRC Generic Technical Activity B-10, Behavior of BWR Mark III Containment. On the basis of certain large-scale tests conducted between 1973 and 1979, the General Electric Company developed LOCA-related hydrodynamic load definitions for use in the design of the standard Mark III containment. The staff and its consultants have reviewed these load definitions and their bases and conclude that, with a few specified changes, the proposed load definitions provide conservative loading conditions. The staff approved acceptance criteria for LOCA-related hydrodynamic loads are provided in an appendix.

47861 (NUREG—1054) Simplified analysis for liquid pathway studies. Codell, R.B. Aug 1984. 119p. NTIS, PC A06/MF A01 - GPO* $5.00. File Number TI84901882.

The analysis of the potential contamination of surface water via groundwater contamination from severe nuclear accidents is routinely calculated during licensing reviews. This analysis is facilitated by the methods described in this report, which is codified into a BASIC language computer program, SCREENLP. This program performs simplified calculations for groundwater and surface water transport and calculates population doses to potential users for the contaminated water irrespective of possible mitigation methods. The results are then compared to similar analyses performed using data for the generic sites in NUREG-0440, Liquid Pathway Generic Study, to determine if the site being investigated would pose any unusual liquid pathway hazards.

47862 **(NUREG—1068) Review insights on the probabilistic risk assessment for the Limerick Generating Station.** Aug 1984. 114p. NTIS, PC A06/MF A01 - GPO* $5.00. File Number TI84901884.

In recognition of the high population density around the Limerick Generating Station site and the proposed power level, the Philadelphia Electric Company, in response to NRC staff requests, conducted and submitted between March 1981 and November 1983 a probabilistic risk assessment (PRA) on internal event contributors and a severe accident risk assessment on external event contributors to assess risks posed by operation of the plant. The applicant has developed perspectives using PRA models on the safety profile of the Limerick plant and has altered the plant design to reduce accident vulnerabilities identified in these PRAs. The staff's review of the Limerick PRA has particularly emphasized the dominant accident sequences and the resulting insights into demonstration of compliance with regulatory requirments, unique design features and major plant vulnerabilities to assess the need for any additional measures to further improve the safety of the LGS. The staff's review insights and PRA safety review conclusions are presented in this report.

47863 **(NUREG/CR—1799) Advanced Reactor Safety Research Division. Quarterly progress report, July 1-September 30, 1980.** Ramano, A.J. (comp.). (Brookhaven National Lab., Upton, NY (USA)). Nov 1980. Contract AC02-76CH00016. 144p. (BNL-NUREG—51297). NTIS, PC A07/MF A01 - GPO. File Number TI84017650.

The Advanced Reactor Safety Research Programs Quarterly Progress Report describes current activities and technical progress in the programs at Brookhaven National Laboratory sponsored by the USNRC Division of Reactor Safety Research. The projects reported each quarter are the following: HTGR Safety Evaluation, SSC Code Development, LMFBR Safety Experiments, and Fast Reactor Safety Code Validation.

47864 **(NUREG/CR—2000-Vol.3-No.8) Licensee Event Report (LER) compilation for month of August 1984. Volume 3, No. 8.** (Oak Ridge National Lab., TN (USA)). Sep 1984. Contract AC05-84OR21400. 69p. (ORNL/NSIC—200-Vol.3-No.8). NTIS, PC A04/MF A01 - GPO. File Number TI85001935.

This monthly report contains Licensee Event Report (LER) operational information that was processed into the LER data file of the Nuclear Safety Information Center (NSIC) during the one month period identified on the cover of this document. The LERs, from which this information is derived, are submitted to the Nuclear Regulatory Commission (NRC) by nuclear power plant licensees in accordance with federal regulations. Procedures for LER reporting are described in detail in NRC Regulatory Guide 1.16 and NUREG-0161, Instructions for Preparation of Data Entry Sheets for Licensee Event Reports. The LER summaries in this report are arranged alphabetically by facility name and then chronologically by event date for each facility. Component, system keywords, and component vendor indexes follow the summaries. The components, systems, and vendors are assigned by the computer using correlation tables from the Sequence Coding and Search System.

47865 **(NUREG/CR—2159) Comparative analysis of the International Standard Problem 8 calculations.** Saha, P.; Rohatgi, U.S.; Neymotin, L.; Slovik, G. (Brookhaven National Lab., Upton, NY (USA)). Mar 1981. Contract AC02-76CH00016. 162p. (BNL-NUREG—51399). NTIS, PC A08/MF A01 - GPO. File Number TI84017627.

This report is the final documentation of the comparison of various calculations for International Standard Problem 8 (ISP8), which consists of Semiscale Test S-06-3 with 200 percent cold leg break. The test was performed to simulate the blowdown, refill, and reflood stages of the LOFT Nuclear Test L2-3. The test was predicted by various organizations using different codes such as RELAP4/MOD5, RELAP4/MOD6, RELAP-UK, ALARM-P1, DRUFAN. Results of these calculations have been discussed and compared with the test data according to the successive stages of the accident and the type of code used. The observations regarding the user dependence and performance of these five codes are also reported. Also, a comparison between the RELAP4/MOD6 and the RELAP4/MOD7 calculations has been presented in the Appendix.

47866 **(NUREG/CR—2189-Vol.1) Probability of pipe fracture in the primary coolant loop of a PWR plant. Volume 1. Summary, Load Combination Program. Project I final report.** Lu, S.; Streit, R.D.; Chou, C.K. (Lawrence Livermore National Lab., CA (USA)). Jun 1981. Contract W-7405-ENG-48. 57p. (UCID—18967-Vol.1). NTIS, PC A04/MF A01 - GPO. File Number TI84017628.

This report summarizes work performed to establish a technical basis for the NRC to use in reassessing its requirement that earthquake and large loss-of-coolant accident (LOCA) loads be combined in the design of nuclear power plants. A systematic probabilistic approach is used to treat the random nature of earthquake and transient loading and to estimate the probability of large LOCAs that are directly and indirectly induced by earthquakes. A large LOCA is defined in this report as a double-ended guillotine break of the primary reactor coolant loop piping (the hot leg, cold leg, and crossover) of a pressurized water reactor (PWR). Unit 1 of the Zion Nuclear Power Plant, a four-loop PWR, is the demonstration plant used in this study. To estimate the probability of a large LOCA directly induced by earthquakes, only fatigue crack growth resulting from the combined effects of thermal, pressure, seismic, and other cyclic loads is considered. Fatigue crack growth is simulated by a deterministic fracture mechanics model with stochastic inputs of initial crack size distribution, material properties, stress histories, and leak detection probability. Results of the simulation indicate that the probability of a double-ended guillotine break, either with or without earthquake, is very small (on the order of 10^{-12}). The probability of a leak was found to be several orders of magnitude greater than that of a large LOCA, complete pipe rupture. A limited investigation involving engineering judgment of a double-ended guillotine break indirectly induced by an earthquake is also reported.

47867 **(NUREG/CR—2331-Vol.3-No.4) Safety research programs sponsored by Office of Nuclear Regulatory Research. Quarterly progress report, October 1-December 31, 1983. Volume 3, No. 4.** Weiss, A.J. (comp.). (Brookhaven National Lab., Upton, NY (USA)). May 1984. Contract AC02-76CH00016. 127p. (BNL-NUREG—51454-Vol.3-No.4). NTIS, PC A07/MF A01 - GPO; GPO Dep. File Number TI84016812.

The projects reported are the following: High Temperature Reactor Research, SSC Development, Validation and Application, CRBR Balance of Plant Modeling, Thermal-Hydraulic Reactor Safety Experiments, Development of Plant Analyzer, Code Assessment and Application (Transient and LOCA Analyses), Thermal Reactor Code Development (RAMONA-3B), Calculational Quality Assurance in Support of PTS; Stress Corrosion Cracking of PWR Steam Generator Tubing, Bolting Failure Analysis, Probability Based Load Combinations for Design of Category I Structures, Mechanical Piping Benchmark Problems, Identification of Age-Related Failure Modes; Analysis of Human Error Data for Nuclear Power Plant Safety-Related Events, Human Factors in Nuclear Power Plant Safeguards, Emergency Action Levels, and Protective Action Decision Making.

47868 **(NUREG/CR—3169) Super System Code (SSC, Rev.0), an advanced thermohydraulic simulation code for transients in LMFBRs.** Guppy, J.G. (Brookhaven National Lab., Upton, NY (USA)). Apr 1983. Contract AC02-76CH00016. 462p. (BNL-NUREG—51650). NTIS, PC A20/MF A01 - GPO. File Number TI84017268.

The Super System Code (SSC) calculates the response of nuclear reactor systems during operational, incidental and accidental transients, especially natural circulation events. Modules simulated and parameters calculated include: core flow rates and temperatures, loop flow rates and temperatures, pump performance, and heat exchanger operation. Additionally, all plant protection systems and plant control systems are accounted for. All calculations are done in SI units. SSC is a general system transient code. It is highly flexible, with complete variable dimensioning, allowing any number of user specified loops, pipes and nodes. Single phase and two phase thermal hydraulics are used in a multi-channel core representation. Interassembly flow redistribution is accounted for; a detailed fuel pin model is used. The heat transport system geometry is user specified. The code has both transient and steady state options. Restart capability is provided. SSC is available in either a CDC UPDATE format or as FORTRAN source. The customary transmittal package also includes the input files for the three standard benchmark problems, as well as 48x microfiche which contain the SSC support documentation and sample output for each of the benchmark problems. SSC is currently available as a draft release from Brookhaven National Laboratory with NRC consent.

47869 **(NUREG/CR—3190) PLUGM: a coupled thermal-hydraulic computer model for freezing melt flow in a channel.** Pilch, M.; Mast, P.K. (Sandia National Labs., Albuquerque, NM (USA); Science Applications, Inc., Albuquerque, NM (USA)). Apr 1984. Contract AC04-76DP00789. 156p. (SAND—82-1580). NTIS, PC A08/MF A01 - GPO. File Number TI85001945.

PLUGM models the flow and freezing of molten material in a nonmelting channel. PLUGM is being developed for applications in Sandia's Ex-Vessel Core Retention Materials Assessment Program and in Sandia's LMFBR Transition-Phase Program. PLUGM models time-dependent flow from a reservoir, through a channel and possibly into a catch tank. Three user-specified geometry options enable realistic modeling of melt flow and freezing in tubes, thin slits, and particle beds. Axial variation of relevant channel parameters is possible. Melt flow is driven or hindered by gravity, applied pressure, and capillary pressure. Hydrodynamic losses due to friction, area changes, and flow direction changes are modeled. Also modeled are the competing effects of mass addition to the reservoir, mass drainage into the channel, and slug depletion by film and crust deposition on the channel wall. Cooldown of a superheated melt occurs by material transport down the channel and by convective heat transfer to the channel walls or crust. Axial conduction and volumetric heating within the bulk melt are not modeled. Crust deposition on the channel wall is controlled by the competing effects of convective heat transfer from the bulk melt to the crust surface and the conduction limited removal of heat from the crust into the wall. An external coolant may further enhance this heat removal by limiting the temperature increase in the wall. Sample problems, pertaining to ex-vessel core retention and LMFBR transition phase, illustrate features and capabilities of the code.

47870 **(NUREG/CR—3418) Screening tests of terminal block performance in a simulated LOCA environment.** Craft, C.M. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1984. Contract AC04-76DP00789. 275p. (SAND—83-1617). NTIS, PC A12/MF A01 - GPO. File Number TI85001389.

Twenty-four terminal blocks were tested in simulated Design Basis Event (DBE), Loss of Coolant Accident (LOCA) environments. The terminal blocks were powered at voltages of 4 Vdc, 45 Vdc, and 125 Vdc. Resulting currents associated with these voltage levels were 1.8 mA, 20 mA, and 1 A, respectively. Terminal-to-terminal and terminal-to-ground leakage currents were monitored on a discrete time basis throughout the test. Based on these measurements, insulation resistances were calculated. During exposure to the LOCA steam environment insulation resistance was observed to decrease from initial values of 10^8 to 10^{10} ohms to 10^2 to 10^5 ohms. These decreases in IR are interpreted as being caused by conduction in surface moisture films rather than bulk conduction through the insulation material. Insulation resistance for all applied voltage levels appear to be approximately the same. Sporadic breakdowns lasting from fractions of a second to several minutes were observed. Further, rapid increases in applied voltage caused large decreases in insulation resistance. The measured IR was also dependent upon temperature. Subsequent to the test, terminal block insulation resistance returned to acceptable levels (10^6 to 10^8 ohms), though not to pre-test levels. The comparison of spray and no-spray results shows that no discernable difference in IRs existed between the periods with and without chemical spray.

47871 **(NUREG/CR—3460) Experiment data report for Multirod Burst Test (MRBT) bundle B-6.** Chapman, R.H.; Longest, A.W.; Crowley, J.L. (Oak Ridge National Lab., TN (USA)). Jul 1984. Contract AC05-84OR21400. 152p. (ORNL/TM—8890). NTIS, PC E07/MF A01 - GPO. File Number TI84015734.

Includes 6 sheets of 48x reduction microfiche.

A reference source of MRBT bundle B-6 test data is presented with minimum interpretation. The primary objective of this 8 x 8 multirod burst test was to investigate cladding deformation in the alpha-plus-beta-Zircaloy temperature range under simulated light-water-reactor (LWR) loss-of-coolant accident (LOCA) conditions. B-6 test conditions simulated the adiabatic heatup (reheat) phase of an LOCA and produced very uniform temperature distributions. The fuel pin simulators were electrically heated (average linear power generation of 1.42 kW/m) and were slightly cooled with a very low flow ($Re \sim 140$) of low-pressure superheated steam. The cladding temperature increased from the initial temperature (330°C) to the burst temperature at a rate of 3.5°C/s. The simulators burst in a very narrow temperature range, with an average of 930°C. Cladding burst strain ranged from 21 to 56%, with an average of 31%. Volumetric expansion over the heated length of the cladding ranged from 16 to 32%, with an average of 23%. 23 references.

47872 **(NUREG/CR—3469-Vol.1) Occupational dose reduction at nuclear power plants. Annotated bibliography of selected readings in radiation protection and ALARA. Volume 1.** Baum, J.W.; Schult, D.A. (Brookhaven National Lab., Upton, NY (USA)). Feb 1984. Contract AC02-76CH00016. 126p. (BNL-NUREG—51708-Vol.1). NTIS, PC A07/MF A01 - GPO. File Number TI84017271.

This report is the first in a series on dose reduction at nuclear power plants. It consists of abstracts selected primarily from Applied Health Physics Abstracts and Notes Volume 6, No. 1, 1980 thorugh Volume 9, No. 1, January, 1983 on doses, dose reduction techniques and related topics.

47873 **(NUREG/CR—3617) Noble gas, iodine, and cesium transport in a postulated loss of decay heat removal accident at Browns Ferry.** Wichner, R.P.; Hodge, S.A.; Weber, C.F.; Beahm, E.C.; Wright, A.L. (Oak Ridge National Lab., TN (USA)). Aug 1984. Contract AC05-84OR21400. 197p. (ORNL/TM—9028). NTIS, PC A09/MF A01 - GPO. File Number TI84016399.

This report presents an analysis of the movement of noble gas, iodine, and cesium fission products within the Mark-I containment BWR reactor system represented by Browns Ferry Unit 1 during a postulated accident sequence initiated by a loss of decay heat removal capability following a scram. The event analysis showed that this accident could be brought under control by various means, but the sequence with no operator action ultimately leads to containment (drywell) failure followed by loss of water from the reactor vessel, core degradation due to overheating, and reactor vessel failure with attendant movement of core debris onto the drywell floor. The analysis of fission product transport presented in this report is based on the no-operator-action sequence and provides an estimate of fission product inventories, as a function of time, within 14 control volumes outside the core, with the atmosphere considered as the final control volume in the transport sequence. As in the case of accident sequences previously studied, we find small barrier for noble gas ejection to air, these gases being effectively purged from the drywell and reactor building by steam and concrete degradation gases. However, significant decay of krypton isotopes occurs during the long delay times involved in this sequence. In contrast, large degrees of holdup for iodine and cesium are projected due to the chemical reactivity of these elements. Only about 2×10^{-4}% of the initial iodine and cesium activity are predicted to be released to the atmosphere. Principal barriers for release are deposition on reactor vessel and containment walls. A significant amount of iodine is captured in the water pool formed in the reactor building basement after actuation of the fire protection system.

47874 (NUREG/CR—3660-Vol.2) **Probability of pipe failure in the reactor coolant loops of Westinghouse PWR plants. Volume 2. Pipe failure induced by crack growth. Load Combination Program.** Woo, H.H.; Mensing, R.W.; Benda, B.J. (Lawrence Livermore National Lab., CA (USA)). Jan 1984. Contract W-7405-ENG-48. 70p. (UCID—19988-Vol.2). NTIS, PC A04/MF A01 - GPO; GPO Dep. File Number TI84014704.

This report assesses the probability of reactor coolant loop (RCL) piping failures resulting from a crack growth mechanism. The Westinghouse pressurized water reactor (PWR) plants in the United States east of the Rocky Mountains are considered. After the introduction (Section 1), the assessment is presented in five parts (Sections 2 to 6). Section 2 describes the characteristics of RCL piping in these Westinghouse PWR plants. Section 3 describes the methodology used in the analysis. Sections 4 and 5 present the best-estimate and uncertainty analyses, respectively. Our conclusions are presented in Section 6, along with recommended items for consideration in future licensing regulations.

47875 (NUREG/CR—3665-Vol.1) **Optimization of public and occupational radiation protection at nuclear power plants. A review of occupational dose assessment considerations in current probabilistic risk assessments and cost-benefit analyses. Vol. 1.** Lobner, P. (Science Applications, Inc., Pleasanton, CA (USA)). Sep 1984. 59p. (SAI—83/1125-Vol.1). NTIS, PC A04/MF A01 - GPO* $4.50. File Number TI85900067.

This report reviews current value-impact analysis and probabilistic risk assessment methods and discusses the manner and degree to which these methods consider occupational radiation exposure that may form a variety of in-plant activities, including: (1) normal operation and maintenance, (2) repair, (3) retrofit, (4) minor incidents and cleanup, (5) major accidents, and (6) decommissioning. Value-impact analysis methods which include occupational exposure as an element of the value-impact equation have been developed, however, no standard approach to such analysis has been adopted. Comparison of the results of value-impact analyses must, therefore, be done with caution because different value-laden assumptions made by the analyst can have strong effects on the outcome. Such assumptions include the monetary equivalent of a person-rem, and the relative value of occupational and public exposure. Probabilistic methods have been used in value-impact evaluations to quantify incremental or averted occupational exposure from reactor accidents, however, occupational exposure has not been addressed in probabilistic risk assessments (PRAs) of nuclear power plants. Consideration of occupational exposure in a PRA would greatly increase the complexity of the plant model and the benefits from such an analysis are uncertain. In lieu of expanding the scope of PRAs to address occupational risk, the separate, limited-scope probabilistic evaluations developed for value-impact analysis should provide a more practical analytical capability to support the evaluation and optimization of occupational and public radiation exposure.

47876 (NUREG/CR—3665-Vol.2) **Optimization of public and occupational radiation protection at nuclear power plants. Volume 2. Considerations in factoring occupational dose into value-impact and cost-benefit analyses.** Cohen, J.J. (Science Applications, Inc., Pleasanton, CA (USA)). Sep 1984. 46p. (SAI—84/1010-Vol.2). NTIS, PC A03/MF A01 - GPO* $4.00. File Number TI85900066.

Many NRC decisions intended for the improvement of public health and safety involve concomitant increases in occupational radiation exposure. Previous study (Volume 1) indicates that occupational dose consequences generally have not been considered in cost-benefit and value-impact analyses supporting decisions related to public safety. Such consideration, however, would be consistent with ALARA guidance. This study derives a methodology for factoring occupational dose into cost-benefit analyses. The related issues include: evaluation of occupational vs public radiation exposure, stochastic vs non-stochastic effects, probabilistic risk considerations, uncertainty, and de minimus levels.

47877 (NUREG/CR—3665-Vol.3) **Optimization of public and occupational radiation protection at nuclear power plants: a calculation method. Volume 3.** Horton, W.H. (Science Applications, Inc., Pleasanton, CA (USA)). Sep 1984. 220p. (SAI—84/3037-Vol.3). NTIS, PC A10/MF A01 - GPO* $6.50. File Number TI85900065.

The methodology presented in this report formulates an approach for the optimization of benefits resulting from NRC decision making processes. Recent increases in occupational exposures in nuclear power plants resulting from NRC regulatory practices have led to the questioning by NRC of the overall benefit of specific regulations. The optimization methodology in this report provides a tool for the determination of the cost-benefit of proposed NRC regulations. Detailed methods are presented for the modeling of plant safety systems undergoing inspection, testing, and/or repair. This methodology utilizes dynamic Markov modeling techniques with extensive additional model development associated with operator errors involved in the inspection, test, and repair activities of the plant. Closed form solutions to the Markov models are provided. The report appendix presents the Markov model solution process in detail sufficient for model verification. Other methods necessary for the optimization process are discussed in lesser detail. An application of the methodology dealing with steam generator inspection frequency and steam generator tube rupture events is presented. The example determines the steam generator inspection intervals which minimize expected costs and total expected occupational and public dose.

47878 (NUREG/CR—3724) **Ultimate strength analyses of the Watts Bar, Maine Yankee, and Bellefonte containments.** Jung, J. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1984. Contract AC04-76DP00789. 80p. (SAND—84-0660). NTIS, PC A05/MF A01 - GPO. File Number TI84017317.

As part of Sandia National Laboratories' Severe Accident Sequence Analysis (SASA) Program, structural analyses of the Watts Bar, Maine Yankee, and Bellefonte containment structures were performed with the obtective of obtaining realistic estimates of their ultimate static pressure capacities. The Watts Bar investigation included analyses of the containment shell, equipment hatch, anchorage systems, and personnel lock. The ultimate pressure capability is estimated to be between 120 and 137 psig, corresponding to shell yielding and equipment hatch buckling, respectively. The Maine yankee investigation consisted of an analysis of the containment shell and estimated its failure pressure to be between 96 and 118 psig. For the Bellefonte containment, analyses of the containment shell and equipment hatch were performed. The pressure capacity of the Bellefonte containment is estimated to be between 130 and 139 psig, corresponding to dome tendon yielding and cylinder wall tendon yielding, respectively.

47879 (NUREG/CR—3776) **Testing of safety-related nuclear power plant equipment at the Central Receiver Test Facility.** Dandini, V.J.; Aragon, J.J. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1984. Contract AC04-76DP00789. 84p. (SAND—83-1960). NTIS, PC A05/MF A01 - GPO. File Number TI85001605.

The use of a solar energy facility for simulating the thermal environment (heat flux) produced as a result of hydrogen burns in a full-scale reactor containment building is described. Using a heat flux profile developed from calculations performed by the HECTR computer code, the Central Receiver Test Facility simulated the multiple burn thermal environment which HECTR predicted would result from the deliberate ignition of hydrogen generated by an S_2D accident. Functioning specimens of reactor monitoring and safety system equipment were exposed to this environment. Results of the equipment performance and temperature response are presented.

47880 (NUREG/CR—3868) **Containment building atmosphere response due to reactor gas burning under remote severe accident conditions.** Kroeger, P.G. (Brookhaven National Lab., Upton, NY (USA)). Jun 1984. Contract AC02-76CH00016. 42p. (BNL-NUREG—51793). NTIS, PC A03/MF A01 - GPO. File Number TI84016810.

The formation of combustible atmospheres during unrestricted core heatup accidents in High Temperature Gas-Cooled Reactors is being investigated, considering the effects of only partially mixed atmospheres. It is found that the previosly used assumption of complete mixing presents the more severe limit in most cases. In the few cases where higher loads were obtained, these were still below the containment building failure limits, and did apply only locally. Furthermore these cases required the invocation of even more remote failure scenarios. A qualitative discussion applying the above results to corresponding accidents at Fort St. Vrain is included.

47881 (NUREG/CR—3893) Laboratory studies: dynamic response of prototypical piping systems. Final report. Howard, G.E.; Walton, W.B.; Johnson, B.A. (Anco Engineers, Inc., Culver City, CA (USA)). Aug 1984. 100p. NTIS, PC A05/MF A01 - GPO* $4.75. File Number TI84901914.

This report presents details of the test methods, specimens and a preliminary assessment of results. Two test configurations will be used to achieve the project objectives. Both were three dimensional configurations; the second configuration had branch pipes. The piping systems sustained no apparent damage after being subjected to an earthquake approximately four times greater than the SSE. Additionally, one of the piping system resisted five OBEs, nine SSEs and nearly thirty schocks.

47882 (SAND—84-0419C) DF-1: an ACRR separate effects experiment on severe fuel damage. Marshall, A.C.; Pickard, P.S.; Reil, K.O.; Rivard, J.B.; Stalker, K.T. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 12p. (CONF-840914—15). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84017421.

From International meeting on thermal nuclear reactor safety; Karlsruhe, F.R. Germany (10 Sep 1984).

A series of in-pile experiments addressing LWR severe fuel damage phenomena is being conducted in the ACRR reactor at Sandia National Laboratories. The ACRR Damaged Fuel Relocation (DFR) experiments are separate effects tests which provide a data base for the development and verification of models for LWR severe core damage accidents. The first experiment in this series, DF-1, has been completed and the results and analysis to date are discussed in this paper. DF-1 examined the effect of low initial clad oxidation conditions on fuel damage and relocation processes. Visual observation showed early clad relocation and partial blockage formation at the grid spacer location with significant aerosol production. Oxidation-driven heating rates of 25°K/s and peak temperatures in excess of 2525°K were observed.

47883 (UCID—20164) Seismic fragility of reinforced concrete structures and components for application to nuclear facilities. Gergely, P. (Cornell Univ., Ithaca, NY (USA)). Sep 1984. Contract W-7405-ENG-48. 104p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE84017206.

The failure and fragility analyses of reinforced concrete structures and elements in nuclear reactor facilities within the Seismic Safety Margins Research Program (SSMRP) at the Lawrence Livermore National Laboratory are evaluated. Uncertainties in material modeling, behavior of low shear walls, and seismic risk assessment for nonlinear response receive special attention. Problems with ductility-based spectral deamplification and prediction of the stiffness of reinforced concrete walls at low stress levels are examined. It is recommended to use relatively low damping values in connection with ductility-based response reductions. The study of static nonlinear force-deflection curves is advocated for better nonlinear dynamic response predictions. Several details of the seismic risk analysis of the Zion plant are also evaluated. 73 references.

47884 (UCRL—91462) Logic flowgraph model for disturbance analysis of a PWR pressurizer system. Guarro, S.; Okrent, D. (Lawrence Livermore National Lab., CA (USA); California Univ., Los Angeles (USA). School of Engineering and Applied Science). 1984. Contract W-7405-ENG-48. 10p. (CONF-840914—14). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84017023.

From International meeting on thermal nuclear reactor safety; Karlsruhe, F.R. Germany (10 Sep 1984).

The Logic Flowgraph Methodology (LFM) has been developed as a synthetic simulation language for process reliability or disturbance analysis applications. A Disturbance Analysis System (DAS) using the LFM models can store the necessary information concerning a given process in an efficient way, and automatically construct in real time the diagnostic tree(s) showing the root cause(s) of occurring disturbances. A comprehensive LFM model for a PWR pressurizer system is presented and discussed, and the latest version of the LFM tree synthesis routine, optimized to achieve reduction of computer memory usage, is used to show the LFM diagnoses of selected hypothetic disturbances.

47885 (UCRL—91463) Summary: beyond fault trees to fault graphs. Alesso, H.P.; Prassinos, P.; Smith, C.F. (Lawrence Livermore National Lab., CA (USA)). Sep 1984. Contract W-7405-ENG-48. 24p. (CONF-840295—2-Summ.). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84017022.

From ANS/ENS topical meeting on probabilistic safety methods and applications; San Francisco, CA, USA (24 Feb 1984).

Fault Graphs are the natural evolutionary step over a traditional fault-tree model. A Fault Graph is a failure-oriented directed graph with logic connectives that allows cycles. We intentionally construct the Fault Graph to trace the piping and instrumentation drawing (P and ID) of the system, but with logical AND and OR conditions added. Then we evaluate the Fault Graph with computer codes based on graph-theoretic methods. Fault Graph computer codes are based on graph concepts, such as path set (a set of nodes traveled on a path from one node to another) and reachability (the complete set of all possible paths between any two nodes). These codes are used to find the cut-sets (any minimal set of component failures that will fail the system) and to evaluate the system reliability.

47886 Estimation of structural reliability under combined loads. Shinozuka, M.; Kako, T. (Columbia Univ., New York (USA). Dept. of Civil Engineering and Engineering Mechanics); Hwang, H.; Brown, P.; Reich, M. (Brookhaven National Lab., Upton, NY (USA). Dept. of Nuclear Energy). pp 65-72 of Transactions of the 7. international conference on structural mechanics in reactor technology. Vol. M. Reliability and risk analysis of nuclear power plants. Amsterdam, Netherlands; North-Holland (1983). (CONF-830867—; CONF-830805—; EUR—8596-DE/EN/FR).

From 7. international seminar on computational aspects of the finite element method; Chicago, IL, USA (29 Aug 1983).

For the overall safety evaluation of seismic category I structures subjected to various load combinations, a quantitative measure of the structural reliability in terms of a limit state probability can be conveniently used. For this purpose, the reliability analysis method for dynamic loads, which has recently been developed by the authors, was combined with the existing standard reliability analysis procedure for static and quasi-static loads. The significant parameters that enter into the analysis are: the rate at which each load (dead load, accidental internal pressure, earthquake, etc.) will occur, its duration and intensity. All these parameters are basically random variables for most of the loads to be considered. For dynamic loads, the overall intensity is usually characterized not only by their dynamic components but also by their static components. The structure considered in the present paper is a reinforced concrete containment structure subjected to various static and dynamic loads such as dead loads, accidental pressure, earthquake acceleration, etc. Computations are performed to evaluate the limit state probabilities under each load combination separately and also under all possible combinations of such loads. Indeed, depending on the limit state condition to be specified, these limit state probabilities can indicate which particular load combination provides the dominant contribution to the overall limit state probability. On the other hand, some of the load combinations contribute very little to the overall limit state probability. These observations provide insight into the complex problem of which load combinations must be considered for design, for which limit states and at what level of limit state probabilities.

47887 **Reliability analysis for stiff versus flexible piping systems.** Lu, S.C.; Chou, C.K. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). pp 207-211 of Transactions of the 7. international conference on structural mechanics in reactor technology. Vol. M. Reliability and risk analysis of nuclear power plants. Amsterdam, Netherlands; North-Holland (1983). (CONF-830867—; CONF-830805—; EUR—8596-DE/EN/FR).

From 7. international seminar on computational aspects of the finite element method; Chicago, IL, USA (29 Aug 1983).

This paper describes the program plan and progress to date on a research program entitled, 'Reliability Analysis for Stiff Versus Flexible Piping Systems.' This two and one-half year program was undertaken by the Lawrence Livermore National Laboratory (LLNL) for the U.S. Nuclear Regulatory Commission (NRC) to develop improved requirements for nuclear piping system design. These improvements may involve NRC requirements, industry practice, as well as ASME code specifications. The overall approach to this problem is probabilistic, wherein the reliability of a piping system is evaluated, subject to daily events, transient loads, and postulated seismic events. The reliability model is capable of computing the failure probability of a complete piping system including piping, on-line components, and support devices. The total program is divided into three steps: the first step is to confirm safety concerns introduced by the stiff piping system design; the second step is to develop optimum, or near optimum, piping designs; and the third step is to perform a value impact study and propose changes.

47888 **Reliability assessment of nuclear structural systems.** Reich, M. (Brookhaven National Lab., Upton, NY (USA). Dept. of Nuclear Energy). pp 213-220 of Transactions of the 7. international conference on structural mechanics in reactor technology. Vol. M. Reliability and risk analysis of nuclear power plants. Amsterdam, Netherlands; North-Holland (1983). (CONF-830867—; CONF-830805—; EUR—8596-DE/EN/FR).

From 7. international seminar on computational aspects of the finite element method; Chicago, IL, USA (29 Aug 1983).

Reliability assessment of nuclear structural systems have been receiving more emphasis over the last few years. This paper deals with the recent progress made by the Structural Analysis Division of Brookhaven National Laboratory (BNL), in the development of a probability-based reliability analysis methodology for safety evaluation of reactor containments and other seismic category I structures. An important feature of this methodology is the incorporation of finite element analysis and random vibration theory. By utilizing this method, it is possible to evaluate the safety of nuclear structures under various static and dynamic loads in terms of limit state probability. Progress in other related areas, such as the establishment of probabilistic characteristics for various loads and structural resistance, are also described. Results of an application of the methodology to a realistic reinforced concrete containment subjected to dead and live loads, accidental internal pressures and earthquake ground accelerations are presented.

47889 **Application of the SSMRP methodology to the seismic probabilistic risk analysis at the Zion nuclear power plant.** Bohn, M.P.; Shieh, L.C.; Wells, J.E.; George, L.L.; Mensing, R.W.; Cover, L.E.; Bernreuter, D.L. (California Univ., Livermore (USA). Lawrence Livermore National Lab.); Johnson, J.J. (Structural Mechanics Associates, San Ramon, CA (USA)). pp 261-269 of Transactions of the 7. international conference on structural mechanics in reactor technology. Vol. M. Reliability and risk analysis of nuclear power plants. Amsterdam, Netherlands; North-Holland (1983). (CONF-830867—; CONF-830805—; EUR—8596-DE/EN/FR).

From 7. international seminar on computational aspects of the finite element method; Chicago, IL, USA (29 Aug 1983).

The Seismic Safety Margins Research Program (SSMRP) is a U.S. NRC-funded multiyear program conducted by Lawrence Livermore National Laboratory (LLNL). Its goal is to develop a complete fully coupled analysis procedure (including methods and computer codes) for estimating the risk of an earthquake-induced radioactive release from a commercial nuclear power plant. The analysis procedure is based upon a state-of-the-art evaluation of the current seismic analysis and design process and explicitly accounts for uncertainties inherent in such a process. The SSMRP is the first effort to trace seismically induced failure modes in a reactor system down to the individual component level, and to take into account common cause earthquake-induced failures at the component level. This paper presents the results of our seismic risk analysis of the Zion nuclear power plant using the SSMRP methodology. The risk analysis included a detailed seismological evaluation of the region around Zion, Illinois which provided the earthquake hazard function and an appropriately randomized set of 180 time histories (Having pga values up to 1.8 g). These time histories were used as input to dynamic structural response calculations for four separate Zion buildings. Detailed finite element models of the buildings were used. Calculated time histories at piping support points were then used to determine moments throughout critical piping systems. Twenty-one separate piping systems were analyzed. Finally, the responses of piping and safety system components within the buildings were combined with probabilistic failure criteria and event tree/fault tree models of the plant safety systems to produce an estimate of the probability of core melt and radioactive release due to the occurrence of earthquakes.

47890 **Structural/piping sensitivity studies for the USNRC Seismic Safety Margins Research Program.** Shieh, L.C.; O'Connell, W.J. (California Univ., Livermore (USA). Lawrence Livermore National Lab.); Johnson, J.J. (Structural Mechanics Associates, San Ramon, CA (USA)). pp 271-278 of Transactions of the 7. international conference on structural mechanics in reactor technology. Vol. M. Reliability and risk analysis of nuclear power plants. Amsterdam, Netherlands; North-Holland (1983). (CONF-830867—; CONF-830805—; EUR—8596-DE/EN/FR).

From 7. international seminar on computational aspects of the finite element method; Chicago, IL, USA (29 Aug 1983).

The Seismic Safety Margins Research Program (SSMRP) is a NRC-funded, multi-year program conducted by Lawrence Livermore National Laboratory (LLNL). One of the goals of the program is to develop a complete, fully coupled analysis procedure (including methods and computer codes) for estimating the risk of an earthquake-caused radioactive release from a commercial nuclear power plant. The analysis procedure is based upon a state-of-the-art evaluation of the current seismic analysis and design process and explicitly includes the uncertainties inherent in such a process. The results will be used to improve seismic licensing requirements for nuclear power plants.

47891 **(RISLEY-Trans—4147) Policy of earthquake proof design of sites for atomic furnaces, etc.** (Japan Atomic Energy Research Inst., Tokyo). 9 Sep 1982. Translation of JAERI Memo 6186. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84901857.

In the past earthquake proof design of installations such as atomic furnaces by the Japanese Atomic Energy Research Institute has been carried out individually for each installation in accordance with the National Law and customary practice. However, since some degree of continuity is desirable in the design of earthquake proof installations a Specialist Committee for the Earthquake Proof Design of Atomic Furnaces, etc., was established as a specialist committee of the Atomic Furnace Safety and Inspecting Committee and this committee has established a policy for the design of earthquake proof installations such as atomic furnaces, etc. Contents of this report are basically a discussion of earthquake proof design policy, the background to earthquake proof design policy, difficulties in earthquake proof design policy, design data, methods of calculation, computer programmes, etc., and forms a basis of earthquake proof design policy and data.

47892 **(NUREG/TR—0050) Description of current practice with regard to safety criteria for nuclear power plants.** (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Oct 1978. Translation source information not available . 16p. NTIS, PC A02/MF A01 - GPO*. File Number TI84901965.

In this report, the positions of the Central Union for the Electronics Industry, Register Organization (ZVEI [Central Union for the Electronics Industry], report dated 16 March 1977, -1512.6

Gi/gr -) and the Technical Union of Major Power Plant Operators, Register Organization (VGB [Union of the Graphics Industry], report dated 24 March 1977, -Dr. Eh/Ma-) are included.

47893 (NUREG/TR—0024) Theoretical fundamentals for the SAFTL and CRESS program system to calculate system reliability. Feb 1978. Translation of MRR 164, September 1976. 40p. NTIS, PC A03/MF A01 - GPO*. File Number TI84901966.

The aim of this report is a brief presentation of the methods used in the computer codes SAFTL and CRESS. Apart from the specific procedures of these codes, the background necessary for understanding them is described.

25 ENERGY STORAGE

2501 Magnetic

47894 (LA-UR—84-1949) Design and operating experience of an ac-dc power converter for a superconducting magnetic energy storage unit. Boenig, H.J.; Nielsen, R.G.; Sueker, K.H. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 8p. (CONF-8410100—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84014041.

From IEEE Industry Applications Society meeting; Chicago, IL, USA (1 Oct 1984).

The design philosophy and the operating behavior of a 5.5 kA, +-2.5 kV converter, being the electrical interface between a high voltage transmission system and a 30 MJ superconducting coil, are documented in this paper. Converter short circuit tests, load tests under various control conditions, dc breaker tests for magnet current interruption, and converter failure modes are described.

2505 Flywheels

47895 (N—84-23028) Study of flywheel energy storage for space stations. Final Report. Gross, S. (Boeing Co., Seattle, WA (USA)). Feb 1984. 128p. (NASA-CR—171780). NTIS, PC A07/MF A01.

The potential of flywheel systems for space stations using the Space Operations Center (SOC) as a point of reference is discussed. Comparisons with batteries and regenerative fuel cells are made. In the flywheel energy storage concept, energy is stored in the form of rotational kinetic energy using a spinning wheel. Energy is extracted from the flywheel using an attached electrical generator energy is provided to spin the flywheel by a motor, which operates during sunlight using solar array power. The motor and the generator may or may not be the same device. Flywheel energy storage systems have a very good potential for use in space stations. This system can be superior to alkaline secondary batteries and regenerable fuel cells in most of the areas that are important in spacecraft applications. Of special impotance relative to batteries, are high energy density (lighter weight), longer cycle and operating life, and high efficiency which minimizes the amount of orbital makeup fuel required. In addition, flywheel systems have a long shelf life, give a precise state of charge indication, have modest thermal control needs, are capable of multiple discharges per orbit, have simple ground handling needs, and have the potential for very high discharge rate. Major disadvantages are noted.

2506 Thermal

REFER ALSO TO CITATION(S) 25060048028

47896 Characterization of refrigerant - 12 gas hydrate formation for heat pump cool storage applications. Ternes, M.P. (Oak Ridge National Laboratory, Oak Ridge, TN). *American Society of Mechanical Engineers, [Paper]*; **84-AES-12**: 6(Feb 1984). (CONF-840201—).

From ASME energy sources technology conference and exhibition; New Orleans, LA, USA (12 Feb 1984).

A latent cool storage system for load management applications is currently under development at Oak Ridge National Laboratory. This system utilizes a refrigerant gas hydrate as the storage medium and incorporates storage directly into the heat pump cycle. This paper reviews the chemistry of gas hydrates, describes the conceptual heat pump/cool storage system, and presents the results from experiments performed to understand and characterize the kinetics of the R-12 gas hydrate formation process.

2508 Chemical

47897 The impact of monoblock design and battery packaging on temperature excursion of nickel/iron batteries. Lee, J.; Christianson, C.C.; Yao, N.P. (Chemical Technology Div., Argonne National Laboratory, Argonne, IL). *SAE (Society of Automotive Engineers) Preprint;* **840473**: 8(Feb 1984).

The impact of monoblock design and battery packaging on the temperature distribution and excursion of the nickel/iron EV batteries was examined by using a generic battery thermal model. It was found that substantial differences in temperature rise and temperature distribution exist between a single cell and a close-pack 5-cell monoblock. During a three hour constant current discharge, the temperature of the monoblock exceeds the temperature limit set by the battery developer. This problem may be alleviated by providing inter-cell air spaces and applying forced air cooling to the battery. The importance of maintaining uniform air flow distribution in a full-scale nickel/iron battery pack was also illustrated using an example.

2509 Batteries

REFER ALSO TO CITATION(S) 25090047610

47898 (N—84-23022) 37.5-kW point design comparison of the nickel-cadmium battery, bipolar nickel-hydrogen battery, and regenerative hydrogen-oxygen fuel cell energy storage subsystems for low Earth orbit. Manzo, M.A.; Hoberecht, M.A. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1984. 11p. (NASA-TM—83651; E—2016). NTIS, PC A02/MF A01.

Nickel-cadmium batteries, bipolar nickel-hydrogen batteries, and regenerative fuel cell storage subsystems were evaluated for use as the storage subsystem in a 37.5 kW power system for space station. Design requirements were set in order to establish a common baseline for comparison purposes. The storage subsystems were compared on the basis of effective energy density, round trip electrical efficiency, total subsystem weight and volume, and life.

47899 (N—84-23024) Design of a 1-kWh bipolar nickel hydrogen battery. Cataldo, R.L. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1984. 9p. (NASA-TM—83647; E—2037). NTIS, PC A02/MF A01.

The design of a nickel hydrogen battery utilizing bipolar construction in a common pressure vessel is discussed. Design features are as follows: 40 ampere-hour capcity, 1 kWh stored energy as a 24 cell battery, 1.8 kW delivered in a LEO Cycle and maximum pulse power of 18.0 kW.

47900 (N—84-23025) Advanced designs for IPV nickel-hydrogen cells. Smithrick, J.J.; Manzo, M.A.; Gonzalez-Sanabria, O.D. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1984. 8p. (NASA-TM—83643; E—2052). NTIS, PC A02/MF A01.

Advanced designs for individual pressure vessel nickel-hydrogen cells have been concieved which should improve the cycle life at deep depths-of-discharge. Features of the designs which are new and not incorporated in either of the contemporary cells (Air Force/Hughes, Comsat) are: (1) use of alternate methods of oxygen recombination, (2) use of serrated edge separators to facilitate movement of gas within the cell while still maintaining required physical contact with the wall wick, and (3) use of an expandable stack to accommodate some of the nickel electrode expansion. The designs also consider electrolyte volume requirements over the life of the cells, and are fully compatible with the Air Force/Hughes design.

47901 **(N—84-23026) Teardown analysis of a ten cell bipolar nickel-hydrogen battery.** Manzo, M.A.; Gonzalez-Sanabria, O.D.; Herzau, J.S.; Scaglione, L.J. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1984. 13p. (NASA-TM—83618; E—2051). NTIS, PC A02/MF A01.

Design studies have identified bipolar nickel-hydrogen batteries as an attractive storage option for high power, high voltage applications. A pre-prototype Ni-H2 battery was designed, assembled and tested in the early phases of a concept verification program. The initial stack was built with available hardware and components from past programs. The stack performed well. After 2000 low-earth-orbit cycles the stack was dismantled in order to allow evaluation and analysis of the design and components. The results of the teardown analysis and recommended modifications are discussed.

47902 **(SAND—83-1770) Battery response to pulse loads: a mathematical model.** Delnick, F.M.; Amos, D.E. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1984. Contract AC04-76DP00789. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85001149.

A mathematical model is used to compute pulse load discharge profiles of cathode-limited batteries. These discharges are characterized by 14 chemical and physical parameters. The total voltage loss within the battery is resolved into component contributions from ionic migration, capacitive relaxation, faradaic reaction, and diffusional mass transport limitations. A BASIC language computer program is supplied.

47903 **(SAND—83-2314) Glass corrosion in liquid lithium.** Salmi, D.R.; Bunker, B.C. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1984. Contract AC04-76DP00789. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85002086.

Several families of glass compositions have been corroded in liquid lithium at 250°C to evaluate their chemical durability for applications in ambient-temperature lithium batteries. We found silicate glasses to be the least durable, followed by aluminoborate and lithium borate glasses. Calcium aluminate and phosphate glasses did not appear to be corroded by liquid lithium. Although some of the observed trends in chemical durability could be explained on the basis of thermodynamics, other factors, such as the variability of sample wetting by liquid lithium, also appear to control reaction kinetics. In general, glass corrodes 100 000 times faster in 250°C liquid lithium than in simulated ambient-temperature lithium battery tests, making the liquid lithium test convenient as an accelerated screening test for battery applications.

47904 **(SAND—84-0769C) Prospects for advanced storage battery technologies.** (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 28p. (CONF-841103—1). NTIS, PC A03/MF A01; GPO Dep. File Number DE84015708.

From International telecommunications energy conference; New Orleans, LA, USA (11 Nov 1984).

The sodium/sulfur, zinc/bromine, lead-acid, and nickel/hydrogen electrochemical energy storage systems are discussed in some detail. The sodium/sulfur and zinc/bromine systems are currently under intensive development. The nickel/hydrogen system has demonstrated long life in aerospace applications and is being investigated for cost reduction potential. The sealed lead-acid system was developed for maintenance-free stationary applications and is considered for other applications. Also discussed briefly are the zinc/chlorine, zinc/ferricyanide, iron/chromium redox, and lithium/metal sulfide systems. Applications requirements are discussed. (LEW)

47905 **(TID—27727) Investigation into and development of a new solid electrolyte system for use in Na-S batteries. Monthly technical progress report, January 1977.** (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 31 Jan 1977. Contract AM01-76EI02295. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84017615.

Ceramic NASICON specimens with densities as high as 97.5% of theoretical have been prepared by means of a modified fabrication procedure that uses longer grinding and final firing times. Dynamic stability tests in molten sodium are being conducted at 200°C in test cells of a new, compact design.

47906 **Membrane separators for circulating electrolyte storage batteries.** Assink, R.A.; Arnold, C. (Sandia National Laboratories, Albuquerque, NM). *Proceedings - Electrochemical Society;* **84-4**: 134-142(Oct 1983). (CONF-831086—).

From Electrochemical Society fall meeting; Washington, DC, USA (9 Oct 1983).

Separator membranes are often the technologically limiting factor in the performance of flowing electrolyte batteries. Several studies designed to understand and improve their performance have been completed. The increased resistance of an anionic membrane when placed in a $FeCl_3$ solution was related to a decrease in the water content of the membrane. A factorial study was used to examine the structure property relationships of anionic permselective membranes. A conductivity model successfully related the resistance of a membrane to its ion exchange capacity and water content.

47907 **The application of supported liquid membrane separators to alkaline secondary batteries.** Pemsler, J.P.; Demsey, M.D. (Castle Technology Corp., Woburn, MA). *Proceedings - Electrochemical Society;* **84-4**: 187-197(Oct 1983). (CONF-831086—).

From Electrochemical Society fall meeting; Washington, DC, USA (9 Oct 1983).

A new separator technology under development utilizes the highly specific transport properties of select organic reagents to provide what is, at least in principal, the ideal alkaline battery, separator. In the case of Ni-Zn cells, by providing a membrane that transports hydroxyl ions and rejects zincate ions the possibility of dendrite shorting is eliminated and, furthermore, attendant benefits may be obtained in zinc shape changes by controlling water transport during charge and discharge. Laboratory Ni-Zn test cells incorporating supported liquid membrane battery separators have been cycled extensively. Cells routinely operate over 100 cycles at moderate current densities. Possible benefits to other alkaline systems such as Ni-Cd and Ag-Zn are also discussed.

47908 **Structure and electrochemical properties of lead dioxides: A review.** Varma, R. (Chemical Technology Division, Argonne National Laboratory, Argonne, IL). *Proceedings - Electrochemical Society;* **84-4**: 267-282(Oct 1983). (CONF-831086—).

From Electrochemical Society fall meeting; Washington, DC, USA (9 Oct 1983).

Recent work on the structure and composition of lead dioxide indicates that the material from lead acid battery plates contain hydrogen and is nonstoichiometric. The relationship of crystal defects to the electrochemical properties of lead dioxide is discussed. The cycling performance of the lead dioxide electrode is limited in several respects, including structural degradation, loss of conductivity, and decrease in surface area of the PbO_2 material.

47909 **AC conductivity of polycrystalline Ca-β''-alumina.** Hellstrom, E.E. (Sandia National Laboratories, Albuquerque, NM). *Proceedings - Electrochemical Society;* **84-4**: 95-108(Oct 1983). (CONF-831086—).

From Electrochemical Society fall meeting; Washington, DC, USA (9 Oct 1983).

Polycrystalline Ca-β''-alumina was prepared from Na-β''-alumina by molten salt exchange in $Ca(NO_3)_2$-$CaCl_2$ and in $CaCl_2$. CaO /SUP ./ $6A1_2O_3$ did not form during the exchange processes. $CaCl_2$ attacks the polycrystalline β''-alumina. AC conductivity data on the polycrystalline material were fitted to an equivalent circuit using a nonlinear least-squared-error fitting program, from which the Ca ion conductivity was extracted. The bulk Ca ion conductivity is $3x10^{-4}$ $(ohm.cm)^{-1}$ at 300°C. Intergranular resistance is thought to dominate the overall Ca ion resistance.

47910 **A new low-melting-point electrolyte $LiNO_3$-KNO_3-$CsNO_3$ for use in intermediate temperature lithium cells.** Wang, J.; Huggins, R.A. (Dept. of Materials Science and Engineering, Stanford Univ., Stanford, CA). *Proceedings - Electrochemical Society;* **84-4**: 64-74(Oct 1983). (CONF-831086—).

From Electrochemical Society fall meeting; Washington, DC, USA (9 Oct 1983).

Molten salts in the $LiNO_3$-KNO_3 system can be used in lithium-based electrochemical cells. They are stable in the presence of elemental lithium and high lithium activity alloys due to the formation of a protective lithium oxide solid electrolyte layer. Their thermodynamic properties allow their use with reversible positive electrodes with potentials between 2.5 and 4.3 V with respect to lithium. This paper reports the possibility of reducing the melting point so that such systems by the introduction of a third component. A ternary eutectic has been found in the $LiNO_3$-KNO_3-$CsNO_3$ system that melts at 96 + or - 2°C. This composition, 35.2-39.8-25.0 m/o, is also stable in the presence of elemental lithium, indicating the formation of a lithium oxide layer. Experiments will be reported on the electrochemical stability range of this low temperature eutectic composition, as well as on the use of lithium cobalt oxides as reversible positive electrode materials in electrochemical cells employing it as an electrolyte.

47911 **Resistance characterization of nickel sulfide electrodes in LiCl-containing molten salt electrolytes.** Redy, L.; Vissers, D. (Chemical Technology Division, Argonne National Laboratory, Argonne, IL). *Proceedings - Electrochemical Society;* **84-4**: 53-63(Oct 1983). (CONF-831086—).

From Electrochemical Society fall meeting; Washington, DC, USA (9 Oct 1983).

The electrode kinetics of a high area loading: (545.6 mAh/cm^2 for the Ni $\rightleftharpoons$ NiS transition), porous nickel sulfide electrode were studied under one-dimensional current distribution in a half-cell-type test arrangement. Area specific resistance values (ASR / SUB t/) were measured under wide variety of conditions: temperature, 450-490°C; current density, 0.01-3A/cm^2; and mechanical stress, 0.11-1.68 kg/cm^2. The ASR /SUB t/ values were used for quantitative characterization of the ohmic-related and electrochemical-related resistances of the electrode bed. When cycled in the Ni $\rightleftharpoons$ NiS transition range, the electrode showed good utilization and excellent power characteristics in an all-lithium-cation (LiFLiCl-LiBr) electrolyte. Capability of continuous cycling at high rates (up to 800 mA/cm^2) was demonstrated. The performance of the electrode was also found to be dependent on the mechanical stress developed in the electrode.

47912 **Statistical analysis of lithium iron sulfide status cell cycle life and failure mode.** Gay, E.C.; Battles, J.E.; Miller, W.E. (Argonne National Lab., IL). *Journal of the Electrochemical Society;* **130**: 1646-1650(Aug 1983). (CONF-821015—).

From Electrochemical Society fall meeting; Detroit, MI, USA (17 Oct 1982).

A statistical model was developed for life cycle testing of electrochemical cell life cycle trials and verified experimentally. The Weibull distribution was selected to predict the end of life for a cell, based on a 20 percent loss of initial stabilized capacity or a decrease to less than 95 percent coulombic efficiency. Groups of 12 or more Li-alloy/FeS cells were cycled to determine the mean time to failure (MTTF) and also to identify the failure modes. The cells were all full size electric vehicle batteries with 150-350 A-hr capacity. The Weibull shape factors were determined and verified in prediction of the number of cell failures in two 10 cell modules. The short circuit failure in the cells with BN-felt and MgO powder separators were found to be caused by the formation of Li-Al protrusions that penetrated the BN-felt separators, and the extrusion of active material at the edge of the electrodes.

29 ENERGY PLANNING AND POLICY

2901 Energy Analysis And Modeling

REFER ALSO TO CITATION(S) 29010047960, 47967, 47969, 47970, 47971, 47972, 47973, 47985, 47986, 48035, 49316

47913 **(LBL—18091) Crossroads in electric utility planning and regulation.** Kahn, E. (Lawrence Berkeley Lab., CA (USA)). Mar 1984. Contract AC03-76SF00098. 278p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE84016768.

This manuscript represents a written version of lecture notes given in Energy and Resources 281 at the University of California, Berkeley, in the Fall of 1983. These notes are intended to form the basis of a textbook on electric utility planning and regulation. Although the current version has been reviewed within the academic community, the utility industry, and state regulatory agencies, it is the purpose of this publication to solicit further review.

47914 **(NBS-SP—670) Intermediate future forecasting system.** Gass, S.I.; Murphy, F.H.; Shaw, S.H. (eds.). (National Bureau of Standards, Washington, DC (USA)). Dec 1983. 146p. (CONF-8208201—). NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE84017607.

From Symposium on the Department of Energy's intermediate future forecasting system; Washington, DC, USA (19 Aug 1982).

The purposes of the Symposium on the Department of Energy's Intermediate Future Forecasting System (IFFS) were: (1) to present to the energy community details of DOE's new energy market model IFFS; and (2) to have an open forum in which IFFS and its major elements could be reviewed and critiqued by external experts. DOE speakers discussed the total system, its software design, and the modeling aspects of oil and gas supply, refineries, electric utilities, coal, and the energy economy. Invited experts critiqued each of these topics and offered suggestions for modifications and improvement. This volume documents the proceedings (papers and discussion) of the Symposium. Separate abstracts have been prepared for each presentation for inclusion in the Energy Data Base.

47915 (NBS-SP—670, pp 4-17) **Introduction to the intermediate future forecasting system.** Murphy, F.H.; Shaw, S.H. (Temple Univ., Philadelphia, PA; Dept. of Energy, Washington, DC). Dec 1983. NTIS, PC A07/MF A01. File Number TI84017607. (CONF-8208201—).

From Symposium on the Department of Energy's intermediate future forecasting system; Washington, DC, USA (19 Aug 1982).

The Energy Information Administration is completing a new energy market model, the Intermediate Future Forecasting System (IFFS). The model will be used to study issues on energy markets. Broadly stated, the model is designed to study government policies affecting energy markets and transitions within energy markets. This paper presents an overview of IFFS. There are two important aspects to the model: how the individual sectors and energy forms are represented and how the individual pieces are combined to provide a unified representation of energy markets. The system organization and an overview of the individual fuel market representations are presented here. 2 figures.

47916 (NBS-SP—670, pp 18-26) **System overview: a comment.** Hogan, W.W. (Harvard Univ., Cambridge, MA). Dec 1983. NTIS, PC A07/MF A01. File Number TI84017607. (CONF-8208201—).

From Symposium on the Department of Energy's intermediate future forecasting system; Washington, DC, USA (19 Aug 1982).

Three elements of the design system of the Intermediate Future Forecasting System (IFFS) are addressed in this paper: manageability, dynamics, and model applications. Policy questions or implications are also briefly discussed. The IFFS is a collection of models with individual components describing each relevant sector.

47917 (NBS-SP—670, pp 27-29) **System implementation and software design.** Shaw, S.H. (Dept. of Energy, Washington, DC). Dec 1983. NTIS, PC A07/MF A01. File Number TI84017607. (CONF-8208201—).

From Symposium on the Department of Energy's intermediate future forecasting system; Washington, DC, USA (19 Aug 1982).

The overall system design of the Intermediate Future Forecasting System (IFFS) is briefly described. The model is organized by fuel types. One sector of the model follows a particular fuel through its production, processing, transport, and consumption (end use). Each module continues to operate until it has converged to an equilibrium within its own fuel market. Because of the effects of one fuel's price and demand on other fuels' price and demand, the overall sequence of fuel module solutions is repeated until the global convergence is achieved. The fuel module organization, data bases, and modularity are also described. 1 figure. (DMC)

47918 (NBS-SP—670, pp 100-105) **Introduction to the energy-economy interactions.** Jorgenson, D.W. (Harvard Univ., Cambridge, MA). Dec 1983. NTIS, PC A07/MF A01. File Number TI84017607. (CONF-8208201—).

From Symposium on the Department of Energy's intermediate future forecasting system; Washington, DC, USA (19 Aug 1982).

The purpose of this modeling effort is to analyze the impact of alternative energy policies with other policies against a backdrop of fixed monetary and fiscal policy. The question to answer is what consequences does this policy have for the growth of the output of the economy and for the composition of its output. The economic module contains two economic models. The flexibility of this approach is that one can select the appropriate tool for each task. This requires links among the different models. These links provide the capability of combining the models for different purposes in an efficient way. The purpose of the economy part of the system is to take the output of the energy part of the system to produce impacts on the GNP and on changes in relative prices. (DMC)

47919 (NBS-SP—670, pp 115-138) **IFFS: an overview.** Hausman, J.A. (Massachusetts Inst. of Tech., Cambridge). Dec 1983. NTIS, PC A07/MF A01. File Number TI84017607. (CONF-8208201—).

From Symposium on the Department of Energy's intermediate future forecasting system; Washington, DC, USA (19 Aug 1982).

The Intermediate Future Forecasting System (IFFS) is described under the headings: overall structure; supply analysis; energy transformation activities; demand; and results. The IFFS models the actual working of energy markets on a year-by-year basis. Thus, its results can be compared to the actual situation in energy markets. This feature is its best attribute and makes it much more favorable than models like PIES, MEFS, and LEAP. The potential also exists for a much more successful integration with a macromodel than has occurred previously. IFFS has the potential for policy analysis and forecasts well beyond other existing EIA models. It closely resembles in its solution framework and architecture many econometric models. Significant improvements still need to be made in IFFS. The most important concern is data on natural gas categories in the supply module. For the IFFS model to predict successfully events up to 1985 (or when deregulation occurs) and after, better data seem necessary. 13 references, 2 figures, 5 tables.

2902 Economics And Sociology

REFER ALSO TO CITATION(S) 29020047433, 47452, 47813, 47913, 47918, 47961, 47974, 47976, 47977, 47978, 49305

47920 (DOE/CE/26409—T1) **Evaluation of the Energy Impact Assistance Program (Section 601 of P.L. 95-620). Final report.** Ramsdell, M.J.; Lago, A.M.; Worthington, H.M.; Burkhardt, J.E.; Wozny, M.C.; Lago, C.M. 15 Aug 1984. Contract AC01-83CE26409. 276p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE84016339.

This report presents the findings of an assessment of the Energy Impact Area Development Assistance Program. Enacted as Section 601 of the Powerplant and Industrial Fuel Use Act of 1978, the program was funded for three Fiscal Years (1979 through 1981). This study documents the activities undertaken by the program, assesses its accomplishments, and identifies implications of this experience for future impact mitigation assistance initiatives. The background, coverage, activities, process evaluation, efficiency and effectiveness evaluation, and implications for future programs are included.

47921 (GAO/HRD—84-64) **States fund an expanded range of activities under low-income home energy assistance block grant.** (General Accounting Office, Washington, DC (USA). Office of the Comptroller General). 27 Jun 1984. 85p. US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760. File Number TI84901895.

Report to the Congress.

The low-income home energy assistance (LIHEA) block grant expanded states' flexibility and authority and permitted funds to be used for a broader range of activities not previously permitted. Unlike other block grants created under the Omnibus Budget Reconciliation Act of 1981, LIHEA received increased appropriations over the level established for the prior program to assist eligible households in meeting the costs of home energy. While heating assistance continued to account for the bulk of expenditures in most states, the majority of the 13 states GAO visited used their new authority to provide weatherization, transfer energy assistance funds to other block grants, and carry over funds to the following year. In addition, states gave increased emphasis to energy crisis assistance. Few changes were made to program management procedures. Overall, state executive and legislative branch officials found the block grant less burdensome and more desirable than the prior program. However, about half the interest groups viewed the block grant as a less desirable method of funding energy assistance programs.

47922 (IIASA-RR—83-33) **Impact of seabed nodule mining: a qualitative analysis.** Tilton, J.E. (International Inst. for Applied Systems Analysis, Laxenburg (Austria)). Dec 1983. 49p. C. File Number TI84901660.

This paper considers the future effects of seabed mining on the cobalt, copper, manganese, and nickel industries, and the implications for producing and consuming states. The analysis is qualitative, or conceptual, in nature. While no effort is made to actually measure or quantify the impacts of seabed mining, important variables that one would have to consider in making such assessments are identified. 32 references, 4 figures, 7 tables.

47923 (INIS-mf—8879) **GKSS annual report 1980.** (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1981. 151p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number DE84780616.

This annual report of the GKSS-Research Centre Geesthacht GmbH contains a survey of the research- and development work done in the year of the report and a survey on the organisation and situation of the society. The R and D programme can be divided in two parts: utilization of nuclear energy; utilization of the sea and the coasts. The first part concerns tasks on the sector of reactor safety compiled to a project which is fully integrated into the programme Reactor Safety of the Federal Ministy for Research and Technology. Development of nuclear-energy propelled vessels is continued to a smaller extent than before. The NS OTTO HAHN stopped operations in 1979. In 1980 a waste-disposed concept for the nuclear waste was developed, on the basis of which the GKSS received permission to put the ship out of service. (orig./RW).

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 29030047946, 48440, 48466, 48467, 48468, 48469, 48470, 48471, 48491

47924 (CONF-8402105—Summ.) **Acid rain: an intergovernmental policy forum.** May 1984. 88p. New York State Senate, Albany, NY 12247. File Number TI85900026.

From Acid rain: an intergovernmental policy forum; Albany, NY, USA (7 Feb 1984).

The various presentations made at the New York State Senate's Acid Rain Policy Forum underscored the uncertainty and intricacy of the complex issue of acid rain. Statements by the panelists illustrated strong divergence of opinion over the many questions surrounding the acid rain problem, such as: what causes acid rain; where does it come from; is it getting worse; what are its impacts; and what are the most appropriate policy options for addressing the issue. If there was one point of consensus, it was that enough evidence exists to support the conclusion that some form of action is appropriate. As one panelist noted, the quick answers are all in, and it will be five or more years before answers to some of the remaining questions are known. Therefore, policymakers will have to make their choices on the basis of incomplete knowledge.

47925 **(EPRI-EL—3581) Proceedings: 1983 PCB seminar.** Addis, G.; Komai, R.Y. (eds.). (Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1984. 487p. (CONF-831287—). Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920501.

From EPRI PCB seminar; Atlanta, GA, USA (6 Dec 1983).

The 1983 EPRI PCB Seminar was held in Atlanta, Georgia on December 6-8, 1983. It was sponsored by EPRI's interdivisional PCB Task Force. It presented utility workers with existing and emerging technologies for lower cost compliance with EPA rules and PCB environmental concerns. The papers in this proceedings are divided into topics as follows: Background; Detection and Analysis of PCBs; Retrofill; Spill Cleanup and Bio-Degradation; PCB Destruction; PCB Fires and PCDF; and Decontamination of Mineral Oil. Technology in some of these areas such as Analysis, PCB Destruction, and Decontamination of Mineral Oil, is maturing. However, other critical topics lacking information, such as polychlorinated dibenzofuran (PCDF) formation, spill clean up, and replacement fluids, have arisen to replace them.

47926 **(GAO/RCED—84-7) Inspection, enforcement, and permitting activities at New Jersey and Tennessee hazardous waste facilities.** (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). 22 Jun 1984. 53p. US General Accounting Office, PO Box 6015, Gaithersburg, MD 20760. File Number TI84901869.

Report to the Chairman, Subcommittee on Commerce, Transportation and Tourism, Committee on Energy and Commerce, House of Representatives.

Facilities where hazardous waste is treated, stored, or disposed of are subject to federal controls. This report presents data on key elements of the hazardous waste regulatory program for New Jersey and Tennessee facilities. Overall, GAO found that: (1) eleven of 14 facilities in Tennessee and 5 of 34 facilities in New Jersey are not in full compliance with ground water monitoring requirements. (2) neither state knew the extent of compliance with financial responsibility requirements which are intended to assure that when facilities close, funds will be available for proper facility closure and postclosure care. (3) infrequent followup was made and few enforcement actions were taken to ensure that violations identified through inspections were corrected during GAO's review period; and (4) EPA and the states have issued relatively few final permits to the estimated 7500 facilities requiring them. EPA recognizes that widespread noncompliance with the Resource Conservation and Recovery Act program requirements exists, and it has recently taken or plans to take actions to improve the inspection, enforcement, and permitting program. However, it was early for GAO to assess whether these actions have been successful.

47927 **(GAO/RCED—84-84) Assessment of new chemical regulation under the Toxic Substances Control Act.** Bowsher, C.A. (General Accounting Office, Washington, DC (USA). Office of the Comptroller General). 15 Jun 1984. 66p. US General Accounting Office, PO Box 6015, Gaithersburg, MD 20760. File Number TI84901868.

The Environmental Protection Agency (EPA) is required to assess risks posed by new chemicals and take appropriate regulatory actions to protect health and the environment against unreasonable risks. This report discusses two major weaknesses in EPA's approach to this task. First, EPA's assessment of risk focuses primarily on the proposed initial use. However, risks posed by the substance can be altered significantly through changes in volume or methods of production or new uses being found for them. EPA does not monitor such changes and thus cannot identify when exposures levels change. Second, EPA has not achieved its enforcement inspections goals to ensure industry compliance with the new chemicals program. GAO recommends that EPA establish reporting requirements and monitoring procedures for new chemicals so that changes that occur in the manufacture and use of new chemicals can be evaluated for potential risks to health and the environment. GAO also recommends that EPA make a more concerted effort to expand enforcement of program requirements.

47928 **(INIS-mf—8876) Future energy supply on the basis of non-polluting power plants.** (Staatsministerium Baden-Wuerttemberg, Stuttgart (Germany, F.R.)). 1983. 211p. (In German). NTIS (US Sales Only), PC A10/MF A01. File Number DE84780614.

The legal limits for SO_2 emissions from large furnaces are a compromise in a difficult political process. The realization of the scheduled investment and production plannings of the public utilities reduces the SO_2 emissions of their power plants already in the medium range by more than 75% of the present values. Due to this fact the public utilities are burdened by a total of some 2,8 thousand million marks during the next ten years. In the short run, the SO_2 emissions of the public utilities could still be lowered if the domestic hard coal could be replaced by low-sulphur import coal. The further expansion of nuclear energy will drastically reduce the SO_2 emissions in spite of an increase of electric power consumption. It's true the limits of ecological knowledge force to a restraint towards the evaluation of the extent of environmental abatements. In case of certain weather conditions, e.g. smog weather conditions, a reduction of the short term SO_2-peak loads can be expected at larger distances by the measures of the public utilities. (orig.).

47929 **(NP—4901915) National Acid Precipitation Assessment Program. Annual report 1983, to the President and Congress.** 1983. 70p. Executive Director-NAPAP, 726 Jackson Place, N.W., Washington, DC 20503. File Number TI84901915.

The goal of the National Acid Precipitation Assessment Program is to develop and progressively improve on an objective and comprehensive information base for use by decisionmakers. This statutory Annual Report to the President and Congress outlines the specific accomplishments of the National Program during the last year (FY 1983), summarizes the current state of scientific knowledge for decisionmakers, and describes the outlook for continued progress by the federally sponsored research effort on acid deposition.

47930 **(PB—84-178060) Application for certification 1984 model year light-duty vehicles - Honda.** 1984. 75p. NTIS, PC $19.50/MF $4.80.

See also PB82-148800 and PB84-178078.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. It also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

47931 **(PB—84-178078) Application for certification 1984 model year light-duty vehicles - Nissan.** 1984. 3302p. NTIS, PC $223.50/MF $15.00.

See also PB82-148859, PB84-178060, and PB84-178086.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. It also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

47932 **(PB—84-178086) Application for certification 1984 model year light-duty vehicles - Isuzu.** 1984. 1076p. NTIS, PC $80.00/MF $8.10.

See also PB83-196238 and PB84-178078.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. It also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

47933 **(PB—84-178102) Application for certification 1984 model year heavy-duty engines - Hino.** 1984. 126p. NTIS, PC $23.00/MF $5.10.

See also PB84-178110.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. It also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

47934 **(PB—84-178110) Application for certification 1984 model year heavy-duty engines - International Harvester.** 1984. 115p. NTIS, PC $22.00/MF $5.10.

See also PB83-196295, PB84-178102 and PB84-178128.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. It also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

47935 **(PB—84-178128) Application for certification 1984 model year heavy-duty engines - Iveco.** 1984. 490p. NTIS, PC $44.50/MF $6.30.

See also PB84-178110 and PB84-178136.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. It also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

47936 **(PB—84-178136) Application for certification 1984 model year heavy-duty diesel engines - General Motors.** 1984. 357p. NTIS, PC $36.50/MF $5.70.

See also PB83-196287, PB84-178128, and PB84-178144.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. It also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

47937 **(PB—84-178144) Application for certification 1984 model year heavy-duty engines - Mack trucks.** 1984. 387p. NTIS, PC $38.50/MF $6.00.

See also PB83-196311, PB84-178136, and PB84-178151.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. It also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

47938 **(PB—84-178151) Application for certification 1984 model year heavy-duty engines - Mercedes-Benz.** 1984. 134p. NTIS, PC $23.50/MF $5.10.

See also PB83-141556 and PB84-178144.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles, or heavy-duty engines submits to EPA an application for certification. In the application, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. It also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. Section 16 of the application contains the results of emission testing, a statement of compliance to the regulations, production engine parameters, and a Summary Sheet Input Form on which issuance of a Certificate of Conformity is based.

47939 **Air pollution and mortality: specification searches using SMSA-based data.** Lipfert, F.W. (Brookhaven National Lab., Upton, NY). *Journal of Environmental Economics and Management;* **11**: No. 3, 208-243(Sep 1984). Contract AC02-76CH00016.

A series of cross-sectional multiple regressions of 1969 and 1970 US mortality rates is presented for up to 112 Standard Metropolitan Statistical Areas (SMSA), against various demographic, environmental, and lifestyle variables. The basic data set is the same as that used by L.B. Lave and E.P. Seskin (Air Pollution and Human Health, Johns Hopkins Univ. Press, Baltimore (1978)) for 1969, except that many more independent explanatory variables have been added. Since not all of these variables were available for all of the SMSAs, there were several data sets analyzed, depending on the selection of independent variables. The regression coefficients for air pollution tended to be quite sensitive to both the inclusion of the new independent variables and the selection of data sets. 28 references, 1 figure, 12 tables.

2904 Natural Resources

REFER ALSO TO CITATION(S) 29040047366, 47368, 47420, 47469, 47588, 47922, 47954, 47998

47940 (CONF-8405234—2) **Alaska resources - to be or not to be - that is the challenge.** Young, D. 7 May 1984. 10p. Greater Seattle Chamber of Commerce, 1200 One Union Square, 6th and Univ., Seattle, WA 98101. File Number TI84901924.

From 3. Alaska Resources conference; Seattle, WA, USA (6 May 1984).

The discussion makes the point that Alaska's resource potential will only be realized if the people of the state recognize that there are others who want no development at all.

47941 (DOE/IA—0009-2-Vol.2, pp 86-88) **Energy-related minerals.** Olive, W.W. Aug 1979. NTIS, PC A08/MF A01. File Number TI84011695.

In Joint Peru/United States report on Peru/United States cooperative energy assessment. Volume 2. Annex 1.

The occurrence and reserves of energy related materials in Peru are summarized. Iron, copper, silver, lead, zinc, tungsten, vanadium, bentonite, barite, fluorite, graphite, limestone, and dolomite are discussed. (DMC)

47942 (DOE/IA—0009-2-Vol.2, pp 89-118) **Water resources and energy in Peru.** Schoff, S.L. Aug 1979. NTIS, PC A08/MF A01. File Number TI84011695.

In Joint Peru/United States report on Peru/United States cooperative energy assessment. Volume 2. Annex 1.

This report summarizes the presently available information regarding the water resources of Peru. It is part of an assessment seeking to identify the interactions of various energy strategies and options, and their potential effects on Peru's energy future. Discussion is presented under the headings: water and energy; geography; climate; precipitation and runoff; physiographic and geologic provinces; water regime of the Pacific watershed; water in deserts; water use in coastal valleys; role of ground water; water in the Atlantic watershed, water use by cities; water use by industry; water use in petroleum production; water use and solar and wind energy; water and diesel-electric power; water and geothermal energy; and water low. (DMC)

47943 (DOE/IA/06316—T2, pp F1-F33) **Water resources and energy development in the Republic of Korea.** Worts, G.F. Jr. Sep 1981. NTIS, PC A12/MF A01. File Number TI84011647.

In Republic of Korea/United States cooperative energy assessment. Volume III. Reference reports. Part 1 of 3 parts.

This report presents findings and recommendations in the fields of precipitation, streamflow, sediment transport, and ground water as related to energy development in the Republic of Korea. The work was completed during the period March 1 to 22, 1980, as part of a cooperative energy-options assessment effort between the Governments of the United States of America and the Republic of Korea. The information was gathered through interviews with Korean scientists and engineers, from existing reports and data compilations, and from supporting material assembled by the US Departments of Energy, Interior, and State. Accordingly, this brief study has produced no new data. The scope of the work was limited to evaluating the adequacy of the water-resources investigations and data-collection programs that have been undertaken to determine possible restrictions on energy production that might develop from the unavailability of water or from competition with other uses of water, principally those for irrigation, and municipal, industrial use, and pollution abatement. Discussion is presented under the headings: precipitation, runoff, sediment transport, ground water, water use (hydroelectric, thermal electric internal combustion power, nuclear power), water losses, and long-term plans. 20 references, 2 figures, 15 tables.

47944 (DOE/IA/06316—T2, pp G1-G33) **Assessment of energy related metals and minerals in the Republic of Korea.** Hall, R.B. Sep 1981. NTIS, PC A12/MF A01. File Number TI84011647.

In Republic of Korea/United States cooperative energy assessment. Volume III. Reference reports. Part 1 of 3 parts.

This report summarizes data gathered during a visit to Korea in early 1980 on the so-called energy related mineral resources in the Republic of Korea. Almost any metal or mineral is energy-related in the sense that it may be necessary, either directly or indirectly, in the production, utilization, or transmission of energy. Conversely, no mineral or metal can be produced without the use of energy. The Republic of Korea has a diverse geologic terrane and a great variety of minerals; however, with the exception of tungsten among the metals, and construction materials, (especially limestone and cement), and a few others among the nonmetals, Korea is not self sufficient in energy-related mineral resources. Dependence on imports of raw ores and concentrates is particularly evident at the Republic's metal refineries. The iron and steel complex at Pohang currently is dependent on imports for more than 90% of the iron ore to feed its furnaces; the aluminum smelter at Ulsan operates entirely on imported alumina; and the Republic's two copper smelters are heavily dependent on imports of ore and concentrate to supplement the meager output of copper ore from domestic mines. Discussed are: ferrous metals, iron, steel, tungsten, manganese, molybdenum nickel and titanium. 26 references, 5 figures.

47945 (DOE/IA/06316—T3, pp D.1-D.13) **Assessment of energy related minerals/commodities in Portugal.** Allingham, J.W. Sep 1981. NTIS, PC A07/MF A01. File Number TI84011696.

In Portugal/United States Cooperative Energy Assessment. Volume III. Reference reports, part 1 of 3 parts.

Despite the bleak preliminary assessment of Portugal's energy-related mineral resources, Portugal has many of the mineral resources required to develop and transmit hydro- and thermally generated electric power in the future. A systematic, detailed exploration program under the Director-General of Mines and Geological Services and supported by the private sector has identified and developed large reserves of iron, copper, zinc, tungsten, and tin, although these minerals have been produced at a relatively low level. Elimination of the metallurgical separation problems of the complex iron-copper-lead-zinc ores and the phosphor-bearing iron ores can considerably increase the production of these base metals. The principal energy-related minerals or commodities produced in Portugal are cement, clay, iron, copper, tin, tungsten, lead, and zinc. Raw materials used in making cement, concrete, and brick, that is, limestone, clay, sand and gravel, are very abundant in the west-central part of Portugal. An assessment of each of these minerals or commodities is presented. 20 references, 3 figures, 1 table.

47946 **(DOE/NBM—4016412) Columbia River Basin Fish and Wildlife Program: Issue Paper 5/capital construction.** 1984. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84016412.

What types of capital construction are appropriate for funding by the Bonneville Power Administration and the Corps of Engineers? This paper discusses the following issues: (1) should the Corps of Engineers construct a bypass system at Lower Monumental Dam and a vertical slot counter at the north fishway at the Dalles Dam; (2) should the Northwest Power Planning Council direct BPA to fund construction of adult passage facilities at Dryden and Tumwater dams; (3) should BPA fund the construction of new hatcheries or structural modifications at existing hatcheries; and (4) should the Council modify some existing program measures for capital construction at several Yakima Basin projects? (ACR)

47947 **(N—84-23937) Mineral resources of Antarctica.** Rowley, P.D.; Williams, P.L.; Pride, D.E. (Geological Survey, Washington, DC (USA)). 1983. 1p. NTIS, PC A04/MF A01.

Metallic and nonmetallic mineral occurrences are abundant in Antarctica. The most significant known deposits are of iron, copper, and coal. In the Precambrian shield of East Antarctica, for example, iron is present as banded iron-formation and as magnetite in veins, pods, and schist. The largest deposits of iron are in the Prince Charles Mountains, where bodies of banded iron-formation at least as thick as 400 m extend, mostly under the ice for at least 120 km. Widely scattered morainal boulders and outcrops of iron-rich rock suggest that undiscovered iron deposits are also distributed over many other parts of East Antarctica. Gondwana reconstructions suggest that many more mineral deposits occur in Antarctica. However, ice covers nearly 98 percent of the continent, and few of the bedrock areas have even been prospected or geologically, geophysically, or geochemically mapped in detail.

47948 **(N—84-23962) Emerging recognition of the nonfuel mineral resources of Arctic Alaska.** Grybeck, D. (Geological Survey, Washington, DC (USA)). 1983. 2p. NTIS, PC A04/MF A01.

Some of the most exciting new mineral discoveries in Alaska during the past two decades were in the Brooks Range, yet conventional wisdom 25 years ago was that northern Alaska was rather unpromising, if not geologically unfavorable for mineral deposits. Nonetheless, what has emerged in the Brooks Range is a mineral frontier, largely as a result of detaild geologic mapping, systematic mineral exploration, better accessibility, and new ore-deposit models.

47949 **Model for minerals activity and decision simulation.** Lee, R. (Oak Ridge National Lab., TN). *Materials and Society;* **8**: No. 3, 551-566(1984). Contract W-7405-ENG-26.

The foundation is provided for an integrated computerized system that can be used to model the long-range supply of minerals in a region. The system consists of a set of individual models that represent major elements of the supply process: geologic endowment, exploration, discovery, development, production, and transportation. Each is represented by a set of submodels and computer subroutines that differ depending on the mineral. The output consists of estimated quantities of resources to be discovered, proved reserves, and production at each point in time over some given time horizon. The results are obtained through Monte Carlo simulation. 34 references, 11 figures.

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 29050047595, 48012

47950 **(WAOENG—84-43) Washington State Energy Office Resources Development and Energy Management Division annual report, 1983.** Jun 1984. 41p. Washington State Energy Office, 400 East Union Ave., Olympia, WA 98504. File Number TI84901921.

The Washington State Energy Office's Resource Development and Energy Management Division Annual Report for Calendar Year 1983 is divided into four major sections: Section I contains a Summary Report of the Division's primary goals, programs, major activities, and 1983 accomplishment highlights. In Section II, extensive listings are presented of the Division's Publications, Documents, Presentations, Division Representation in affiliated organizations, and a breakdown of major renewable resource projects on which staff participated. Section III contains four different sets of Project Technical Assistance charts which categorize some 61 projects which received assistance from staff by the likelihood of project completion, the type of project, the energy and dollar value of the project, and the estimated project completion date. Each of the four sets of charts contain summary totals on all project energy and dollar values. Section IV presents the 1984 workplan for the Division. A listing of the Division staff is contained in Appendix A.

2906 Nuclear Energy

REFER ALSO TO CITATION(S) 29060047468, 47469, 47485, 47770, 47811, 47814, 47923, 47928, 47990, 48808

47951 **(AD-A—142197/3) START (Strategic Arms Reduction Talks): problems and prospects. Strategic issues research memo.** Kennedy, R. 1 Nov 1983. 46p. NTIS, PC A03/MF A01.

This memorandum examines origins of SALT and the complexities of the strategic arms control process. It focuses on such problems as those that arise from dissimilar perceptions of threat, differing force structures, growing vulnerabilities, rapid technological change, and the imperatives of verification. The author concludes that many of the same factors that gave impetus to strategic arms control efforts in the late 1960's and early 1970's remain. Thus, despite the chilling of relations between Washington and Moscow as a result of such events as those in Afghanistan, Poland, and Grenada, the Soviet attack on Korean Air Lines 007 and missile deployments in Europe, there is reason for guarded optimism concerning the possibility of another superpower strategic arms control agreement. The Strategic Issues Research Memoranda program of the Strategic Studies Institute, US Army War College, provides a means for timely dissemination of analytical papers which are not necessarily constrained by format or conformity with institutional policy. These memoranda are prepared on subjects of current importance in areas related to the author's professional work or interests. This memorandum was prepared as a contribution to the field of national security research and study.

47952 **(AD-A—142288/0) Politics of arms control and the strategic balance.** Platt, A. (Rand Corp., Santa Monica, CA (USA)). Dec 1982. 30p. NTIS, PC A03/MF A01.

This paper critiques the Carter Administration's strategy for managing the domestic politics of its arms control efforts. It maintains that the Carter Administration made a series of political misjudgements and mistakes, largely prior to the June 1979 signing of SALT II, which undermined congressional and public confidence in the executive branch's stewardship of strategic issues and significantly hurt the treaty's chances for ratification. The author suggests for the Reagan Administration seven lessons learned from the Carter-SALT II experiences. 1) Persuading the Senate to ratify a new SALT agreement will require the direct, continuous, and active participation of the President. 2) Persuading Congress to approve a new SALT agreement must be viewed early on by the President and his administration as a major political campaign. 3) Future SALT agreements must be positively presented as reducing the level of armaments on both sides, rather than merely capping them at relatively high levels. 4) The administration should have its most trusted political professionals continuously and intimately involved in managing the politics of strategic arms control. 5) One senior official should coordinate the political effort. 6) The administration must be clear about the linkage between strategic arms control and the overall context of U.S.-Soviet relations. 7) The administration will have to plan and implement an effective strategy to deal with the legislative branch.

47953 **(ANL/EES-TM—255) BREEDER: a microcomputer program for financial analysis of a large-scale prototype breeder reactor.** Giese, R.F. (Argonne National Lab., IL (USA)). Apr 1984. Contract W-31-109-ENG-38. 237p. NTIS, PC A11/MF A01; GPO Dep. File Number DE85001769.

This report describes a microcomputer-based, single-project financial analysis program: BREEDER. BREEDER is a user-friendly model designed to facilitate frequent and rapid analyses of the financial implications associated with alternative design and financing strategies for electric generating plants and large-scale prototype breeder (LSPB) reactors in particular. The model has proved to be a useful tool in establishing cost goals for LSPB reactors. The program is available on floppy disks for use on an IBM personal computer (or IBM look-a-like) running under PC-DOS or a Kaypro II transportable computer running under CP/M (and many other CP/M machines). The report documents version 1.5 of BREEDER and contains a user's guide. The report also includes a general overview of BREEDER, a summary of hardware requirements, a definition of all required program inputs, a description of all algorithms used in performing the construction-period and operation-period analyses, and a summary of all available reports. The appendixes contain a complete source-code listing, a cross-reference table, a sample interactive session, several sample runs, and additional documentation of the net-equity program option.

47954 (DOE/IA—0009-2-Vol.2, pp 79-83) **Uranium.** Noble, E.A. Aug 1979. NTIS, PC A08/MF A01. File Number TI84011695.

In Joint Peru/United States report on Peru/United States cooperative energy assessment. Volume 2. Annex 1.

No economic uranium deposits have been found in Peru. However, it should be emphasized that geological-geochemical theory has not reached the point from which one can safely predict Peru's uranium potential. Until more is known about uranium's distribution and its behavior under a wide range of conditions, exploration should continue in Peru and in other underexplored areas of South America.

47955 (INIS-mf—9032, pp BB-01-BB-10) **25 years of the Joint Institute for Nuclear Research in Dubna and Czechoslovakia's part in its activities.** Simane, C. (Ceske Vysoke Uceni Technicke, Prague (Czechoslovakia)); Tucek, J. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderne Fyziky). 1981. (In Czech). NTIS (US Sales Only), PC A06/MF A01. File Number TI84780517. (CONF-8108164—Pt.2).

From 7. conference of Czechoslovak physicists; Prague, Czechoslovakia (24 Aug 1981).

The main tasks and results attained by the individual units of the Joint Institute for Nuclear Research in Dubna are briefly described: by the high energy laboratory, the nuclear problems laboratory, the laboratory of theoretical physics, the laboratory of neutron physics, the laboratory of nuclear reactions, the laboratory of computer technology and automation, and by the unit responsible for the implementation of the project for accelerators of positively charged ions based on the principle of collective acceleration using electron rings. Czechoslovakia contributes approximately 6% to the financing of the Institute. Also briefly described are the main fields of cooperation between Czechoslovak research institutes and the laboratories of the Joint Institute for Nuclear Research. (Z.M.).

47956 **Space nuclear reactor program. Hearing before the Subcommittee on Energy Research and Production and the Subcommittee on Space Science and Applications of the Committee on Science and Technology, US House of Representatives, Ninety-Eighth Congress, First Session, May 24, 1983.** Washington, DC, USA; Government Printing Office (1983). 29p.

This report deals with the hearing on space nuclear power systems. From both civilian and defense perspectives, this Nation's space activities of the future will place greater demands upon the on-board electric power supply systems. The activities to be accomplished within the framework of the triagency agreement among DOE, NASA, and DARPA are reviewed. The status of the US technology base is presented in space reactor systems research and development from the viewpoint of a NASA laboratory, two DOE laboratories, and the principal industry participants in the Department's recent technology assessment study.

2907 Transport And Storage

REFER ALSO TO CITATION(S) 29070047442, 47975

2908 Waste Heat Utilization

47957 (DOE/NASA/13111—14-Vol.2) **Cogeneration Technology Alternatives Study (CTAS). Volume II. Comparison and evaluation of results.** (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Aug 1984. Contract AI21-77ET13111. 392p. (NASA-TM—81401-Vol.2). NTIS, PC A17/MF A01; 1; GPO Dep. File Number DE85000346.

The specific objectives of the overall CTAS effort were: (1) to identify and evaluate the most attractive advanced energy conversion systems, for implementation in industrial cogeneration systems between 1985 and 2000, that could permit increased use of coal or coal-derived fuels, and (2) to quantify and assess the advantages of using advanced systems in industrial cogeneration. CTAS was concerned exclusively with providing technical and economic comparisons and evaluations of advanced systems as applied to industrial cogeneration rather than with evaluating the merits of the cogeneration concept. At the request of DOE, nine types of energy conversion systems were evaluated in CTAS: (1) steam turbines, (2) diesel engines, (3) open-cycle gas turbines, (4) combined gas turbine/steam turbine cycles, (5) Stirling engines, (6) closed-cycle gas turbines, (7) phosphoric acid fuel cells, (8) molten carbonate fuel cells, and (9) thermionics. Each type of system was examined with a variety of fuels and over a range of parameters and levels of technological advancement that could be made available for implementation between 1985 and 2000. In addition, for the steam turbine, diesel engine, open-cycle gas turbine, and combined-cycle systems, cogeneration results for technology levels and fuels representative of current commercially available equipment were estimated in order to serve as a baseline for evaluating the advantages of advanced systems. The systems were examined in cogeneration applications in a wide variety of representative industrial process plants selected from the highest energy-consuming industries.

2910 Conservation

REFER ALSO TO CITATION(S) 29100047950, 48013, 48130, 48133, 48135, 48520

47958 (CONF-840570—13) **Role of materials: priorities.** Weir, J.R. Jr. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85001862.

From Materials for future energy systems conference; Washington, DC, USA (1 May 1984).

Energy problems in this country result from the heavy dependence on imported oil. National importance rankings of energy topics are given; the potential exists for materials improvements in these topics. (DLC)

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 29200047436, 47949, 47980, 47995, 48128

47959 (AD-A—141837/5) **Assuring energy supply in a disruption. Final report.** Peterson, D.J.S.; Athay, R.E. Mar 1984. 28p. NTIS, PC A03/MF A01.

DoD has two deficiencies in its supply assurance policy which is used to assure supplies of military fuels, particularly during energy emergencies. First, DoD has no systematic way of assessing the severity of a disruption and second, DoD has not systematic way of deciding which policy options to put into action in response to a particular situation. This report provides a system which eliminates both deficiencies. The system provides a way of defining the severity of a disruption by aggregating all the factors which influence an energy emergency into four dimensions. After the disruption is scoped, the system provides a way of determining which policy options are suitable for the situation. This report also provides an evaluation of the adequacy of current supply assurance policy options and recommends that additional options be developed for an intermediate level disruption.

47960 **(EPRI-EA—3625) Energy-oriented input-output model. Research Project 1366-1.** Hoch, I.; Carson, R.T. Jr. (Resources for the Future, Inc., Washington, DC (USA)). Aug 1984. 306p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920021.

An input-output model was developed to examine the structure of relationships between energy and the general economy, with these phases: (1) development of a base year (1972) model, (2) projection of a year 2000 model, and (3) projection of individual industry output. The base year model was derived from the BEA 496-sector model by aggregating nonenergy sectors, disaggregating energy sectors and putting transactions on a commodity-by-commodity basis. The year 2000 model was obtained by scaling base technical coefficients to account for energy conservation by industry in response to higher prices and major expected changes in technology. Individual industry outputs in dollars were projected on the basis of final demand forecasts obtained by combining several recent alternative forecasts. Total output was projected as 2.5 times the 1972 base level, all energy production as 1.4 the base level, and electricity output as 1.9 its base level. Dollar projections were converted to BTU for the energy sectors by applying a mixed BTU-dollar input-output table which, in practice, accurately accounted for conversion losses in electricity generation. In a final application, energy embodied in US imports were estimated as exceeding energy embodied in US exports, both in 1972 and projected to the year 2000.

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 29300047454, 47770, 47913, 47924, 47926, 47927, 47929, 47956, 47977, 47978, 47999, 48128

47961 **(DOE/RG/10268—T5) Technical assistance to state agencies on economic regulatory policies. Final report.** (National Regulatory Research Inst., Columbus, OH (USA)). 30 Jan 1983. Contract FG01-80RG10268. 54p. NTIS, PC A04/MF A01; GPO Dep. File Number DE84016518.

The purpose of this project is to provide technical assistance to state regulatory agencies, state energy agencies, and non-regulated utilities. Three main types of technical assistance were envisioned at the time: on-site assistance specific to the needs of a particular state agency, generic research assistance tailored to the needs of several states in attempting to solve common regulatory problems, and educational services such as regulatory workshops, roundtables, and conferences. The plan established four major programs to provide assistance to state regulatory commissions: rate design, cost control, computer assisted analysis, and regulatory information exchange. The programs were established based upon input from state commissions, federal agencies, NRRI staff and Board of Directors, and university faculty members. The intent of the program was to establish ongoing areas in which specific projects would be carried out. While the programs were multi-year in length, the projects could vary lasting from as little as two months to two or more years. The objective of each project was to help strengthen the capabilities of state commissions to act effectively in each of the four key program areas. This final report presents the activities, findings, or results achieved under each project for each of the four program areas under the two-year grant extension. Part I contains summaries of projects conducted for the US Department of Energy (DOE) in the first funding period under the grant extension; Part II has the summaries of the second funding period. Projects are organized and summarized by the program areas described previously.

47962 **(DOE/S—0030) Progress in energy, 1983-1984.** (USDOE, Washington, DC). Sep 1984. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85001363.

Two strategies for achieving an adequate supply of energy at reasonable costs are to minimize federal control and intervention in energy markets, while maintaining public health and safety and environmental quality and to seek a balanced and mixed energy resource base. Petroleum, natural gas, coal, synthetic fuels, nuclear, renewables, and conservation are discussed as a part of this mix. The pursuit of fundamental research and development is discussed.

47963 **(RAND/R—2822-EPA) Government allocation of property rights: why and how.** Rolph, E. (Rand Corp., Santa Monica, CA (USA)). Jul 1982. 88p. NTIS, PC A05/MF A01. File Number DE84901925.

As population growth and consumption place mounting stress on resources and on the environment, policymakers have become increasingly interested in ways to limit resources use. One obvious mechanism is the permit program. Under a permit program, the government assigns consumption or use rights to a particular group. At the same time, the program caps the consumption or use allowed by recipients of the rights. Programs that confer rights upon a particular subgroup of the population raise an interesting and unique set of concerns. Who should this group be? On what basis should the allocation be made? Should recipients pay for the benefits? What should the nature of the benefits be? The purpose of our research is to understand how the political process has dealt with these questions in the past and with what results. The study is exploratory and is based on information drawn from 12 cases. The analysis focuses on program designs and on the administrative and evolutionary characteristics of the sample cases. For each case, the following questions were asked: Who receives the right? On what basis is the allocation made? How complete are the property rights that are conferred? And what special trends in program development are discernible? All programs that confer rights or benefits are motivated by one of three objectives. Some exist to move publicly owned resources into the private sector for development. Some exist because patterns of use have created externalities either for the user group or for the public, and the government is called upon to regulate that use. And finally, rights are often conferred upon a group to protest that group from the deleterious effects of a market shift. Once cases are typed according to their motivating objective, clear patterns in design emerge. The criteria determining the quantity of rights a recipient will get show a similar clear pattern.

47964 **Inconstant lady: discovery in administrative adjudications and the evidentiary use of its fruits.** Benkin, I.D. (Federal Energy Regulatory Commission, Washington, DC). *Energy Law Journal;* **4**: No. 2, 201-210(1983).

Today, there are many who maintain that the trend to liberal discovery, especially in complex administrative proceedings, was a mistake that has led to expensive and protracted hearings by the Federal Energy Regulatory Commission. We are currently in a time of re-evaluation and change in the area of administrative process. Teaching the general public, as well as agency members and their staffs, to discern the virtues of the adjudicative process as we now know it is difficult. There is a tendency to view informal rulemaking or "paper hearings" as a universal panacea for the ills that afflict administrative agencies. The legal community must maintain rationality during the proposals for drastic revision of discovery rules. 43 references.

47965 **Enforcement at the Federal Energy Regulatory Commision: considerations for the practitioner.** Doria, M.L.; Lloyd, G. (Federal Energy Regulatory Commission, Washington, DC). *Energy Law Journal;* **4**: No. 1, 39-59(1983).

An overview of the more important aspects of the Federal Energy Regulatory Commission's (FERC) five-year separate enforcement program emphasizes observations and considerations which may be helpful to the practitioner. Beginning with the legal bases for and the due process requirements of FERC investigations, the article then describes the kinds of investigations conducted by the Enforcement Division and a number of matters which may arise during the course of investigations. This includes subpoena enforcement, assertion of the attorney-client privilege, and assertion of reliance upon the advice of counsel. There follows a discussion of the manner in which settlement negotiations are conducted and significant aspects of several settlements recently approved by the Commission. In adopting the approach of self-implementing regulations, the Commission must increasingly insist on the integrity of its processes if regulated entities are to police themselves. 156 references.

47966 **New trial program at the Federal Energy Regulatory Commission.** Moore, C.A. (Federal Energy Regulatory Commission, Washington, DC). *Energy Law Journal;* 3: No. 2, 337-342(1982).

A new trial program began in the summer of 1981 in order to bring the goals and priorities of the Office of the General Counsel (OGC) in line with current needs of the Federal Energy Regulatory Commission (FERC). The author describes shifts in emphasis from trial work to rulemaking and efforts to streamline cases, encourage settlements out of court, and reduce the backlog of case work. In order to meet these goals, the trial staff developed more consistent positions, improved its brief preparation and review, reallocated staff time and efforts, and encouraged an atmosphere conducive to settlement. Pleased with improved staff morale and the increase in settlements, the OGC will continue to pursue staff development. 11 references.

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 29400047367, 47369, 47370, 47419, 47419, 47423, 47423, 47424, 47433, 47433, 47435, 47435, 47436, 47442, 47451, 47452, 47454, 48128

47967 (NBS-SP—670, pp 30-33) **Introduction to the oil and gas supply subsystem.** O'Neill, R.P. (Dept. of Energy, Washington, DC). Dec 1983. NTIS, PC A07/MF A01. File Number TI84017607. (CONF-8208201—).

From Symposium on the Department of Energy's intermediate future forecasting system; Washington, DC, USA (19 Aug 1982).

Three of the oil and gas models used in the Intermediate Future Forecasting System (IFFS) are briefly described. They are PROLOG - the Lower-48 onshore model, OCS - the Outer Continental Shelf model, and AHM - the Alaskan Hydrocarbon model. The PROLOG model was discussed in some detail because it is the newest model. (DMC)

47968 (NBS-SP—670, pp 34-43) **Oil and natural gas supply subsystem: a critique.** Finger, W.R.; Nissen, D. (Exxon Co., Houston, TX; Exxon Corp., New York, NY). Dec 1983. NTIS, PC A07/MF A01. File Number TI84017607. (CONF-8208201—).

From Symposium on the Department of Energy's intermediate future forecasting system; Washington, DC, USA (19 Aug 1982).

The oil and gas supply subsystem of the Intermediate Future Forecasting System (IFFS) is comprised of 3 sub-models: the Alaskan Hydrocarbon Model (AHM), the Outer Continental Shelf Model (OCS), and the Production of Onshore Lower-48 Oil and Gas Model (PROLOG). The first two are discussed briefly, while PROLOG is examined more closely. Also discussed is the simple, parametrically-fitted minimodel of the aggregate price response of oil and gas supply used to represent these models in IFFS. Methodologies in the various components of the model differ sharply. The frontier area models (AHM and OCS) are process and prospect-oriented. Thus they are highly explicit, but at the same time expensive to operate. The onshore Lower-48 model (PROLOG), essentially statistically-based, is a cheaper and less cumbersome way of dealing with a much larger and more varied collection of activities. If modeling is to be useful in the public policy debate, this may represent the right set of methodological choices, but the returns are not yet in. Specifically, PROLOG needs further development before it can be used seriously. 7 references.

47969 (NBS-SP—670, pp 44-51) **Introduction to the oil subsystem.** Conti, J. (Dept. of Energy, Washington, DC). Dec 1983. NTIS, PC A07/MF A01. File Number TI84017607. (CONF-8208201—).

From Symposium on the Department of Energy's intermediate future forecasting system; Washington, DC, USA (19 Aug 1982).

The function of teh oil market module is to determine supply prices of petroleum products given a supply/demand equilibrium in the petroleum market. This paper describes how the module works in estimating refined product prices and downstream unit capacities. 4 references. (DMC)

47970 (NBS-SP—670, pp 52-59) **Refineries subsystem: a critique.** Cleary, N.J. (Standard Oil Co., Chicago, IL). Dec 1983. NTIS, PC A07/MF A01. File Number TI84017607. (CONF-8208201—).

From Symposium on the Department of Energy's intermediate future forecasting system; Washington, DC, USA (19 Aug 1982).

Problems associated with the refineries sub-model of the Intermediate Future Forecasting System (IFFS) are examined. The documentation will require additional work. In its present form it is rated as poor. Reservations are expressed concerning the functional form of the cost equations. This sub-model is compared with the NPC model. (DMC)

47971 (NBS-SP—670, pp 82-92) **Introduction to the coal subsystem.** Hutzler, M.J. (Dept. of Energy, Washington, DC). Dec 1983. NTIS, PC A07/MF A01. File Number TI84017607. (CONF-8208201—).

From Symposium on the Department of Energy's intermediate future forecasting system; Washington, DC, USA (19 Aug 1982).

The IFFS coal market module currently under development is described. The purpose of the coal module is twofold. First, it is to be a policy tool with which the Coal Division can examine legislation that affects the coal industry (e.g., the proposed legislation on coal slurry pipelines that is currently being considered). Second, it is to be used to develop integrated projections of coal supply that are consistent throughout EIA. There are three major components of the module (coal supply, coal transportation, and the demand interface component) and they are in different stages of completion. 8 figures.

47972 (NBS-SP—670, pp 93-95) **IFFS coal supply model.** Gordon, R.L. (Pennsylvania State Univ., University Park). Dec 1983. NTIS, PC A07/MF A01. File Number TI84017607. (CONF-8208201—).

From Symposium on the Department of Energy's intermediate future forecasting system; Washington, DC, USA (19 Aug 1982).

This paper sketches our long-run goals for coal supply analysis. The actual work was at a preliminary stage at the time of the conference and subsequently it was decided to concentrate on simpler first approximation analyses in the present work and delay implementation of the more elaborate approach noted here until later in 1983. Coal supply analysis as it presently exists is briefly discussed.

47973 (NBS-SP—670, pp 96-99) **Coal subsystem: a critique.** Elliot-Jones, M. (Chase Econometrics, Bala Cynwyd, PA). Dec 1983. NTIS, PC A07/MF A01. File Number TI84017607. (CONF-8208201—).

From Symposium on the Department of Energy's intermediate future forecasting system; Washington, DC, USA (19 Aug 1982).

This critique addresses design options of the Coal Subsystem. In particular, the following issues are discussed: (1) does the coal subsystem contain too much or too little detail; (2) should the subsystem include an explicit representation of the contract spot market differentiation; (3) should the supply curves be integrated as stepwise vectors or represented by equation; (4) the excess capacity question; and (5) the migration of coals among categories as a result of preparation.

47974 (NP—5900047) **Persian Gulf: their oil, our need.** Brossard, E.B. 1984. 13p. NTIS, PC A02/MF A01. File Number DE85900047.

The degree of reliance of the US on Persian Gulf petroleum as well as problems facing Persian Gulf nations are addressed in this report. While US dependency on oil imports from Saudi Arabia is down, Japan and other western allies are very dependent on Saudi oil. The consequences of being deprived of Persian Gulf oil are described. The status and implications of the Iran-Iraq war are discussed in detail. The Arab countries in the region fear attacks on their oil fields by enemies and have developed a regional point defense strategy involving Saudi Arabia, Kuwait, Bahrain, Qatar, the United Arab Emirates and Oman. OPEC's role in the area is described. The possibility of US intervention if needed to keep the Strait of Hormuz open and to protect the Gulf states from violence is also addressed. (DMC)

47975 **(NP—5900048) Lower 48's only superport: LOOP.** Brossard, E.B. 1984. 14p. NTIS, PC A02/MF A01. File Number DE85900048.

Historical aspects, constraints, and the operation of Louisiana's Offshore Oil Port (LOOP) are discussed. The facility is described as well as onshore storage and handling facilities and pipelines servicing LOOP. Similarities between LOOP and the Trans Alaska Pipeline System (TAPS) are described. TAPS and LOOP were the US petroleum industry's two biggest projects in the 1970's.

47976 **(PB—84-206937) Experiment in the mediation of grievances. Final report.** Goldberg, S.B.; Brett, J.M. (Northwestern Univ., Chicago, IL (USA)). Apr 1982. 63p. NTIS, PC A04/MF A01.

An experiment in coal mine grievance mediation is analyzed in this report. The experiment was conducted in United Mine Workers' District 28 in Virginia and District 30 in Eastern Kentucky and provided for outside mediation of grievances instead of third step arbitration. The report outlines the design, implementation and administration of the experiment. Comparative data on mediation and arbitration in the two Districts is collected and union and management participants in the program are surveyed. An examination of the results was conducted to determine: a) the outcomes of mediation; b) the speed and cost of mediation; c) the effects of mediation on arbitration; d)attitudes; e) techniques; and f) issues.

47977 **Office of Consumers' Counsel v. FERC.** Satrom, R.C. *Energy Law Journal;* 2: No. 1, 119-133(1981).

In the area of coal gasification, the DC Circuit Court held that the Federal Energy Regulatory Commission (FERC) overstepped its statutory authority in approving a project financing package for the Great Plains plant. The Synthetic Fuels Corporation is now charged with the promotion of synfuels development, while the commission is limited to the regulation of jurisdictional transportation and sales of natural gas, including mixtures of synthetic and natural gas. Costly demonstration projects that the natural gas companies propose in the future will be scrutinized by FERC for certification. While the Commission cannot extend its ratemaking jurisdiction to charge customers for synfuel activities which are not reasonably related to jurisdiction activities, necessary and reasonable cost items should continue to be included in rates when they will provide demonstration benefits related to natural gas suppplies and transportation. 88 references.

2960 Electric Power

REFER ALSO TO CITATION(S) 29600047756, 48133

47978 **(CONF-840919—2) Section 210 of PURPA as seen from a national policy implementation perspective.** Throgmorton, J.A. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 23p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84017490.

From 4. biennial NARUC regulatory information conference; Columbus, OH, USA (5 Sep 1984).

National public policy implementation literature is reviewed. Building upon that review, the paper then derives and tests several expectations (or hypotheses) about the nature and products of Section 210's implementation. After reviewing the process by which President Carter's energy advisors initiated the policy, the study then follows Section 210 through a number of important steps: adoption by Congress, rule-making by the US Federal Energy Regulatory Commission (FERC) and the California Public Utility Commission (CPUC); compliance efforts by the Southern California Edison Company (SoCal Edison); efforts to develop grid-connected wind energy systems in the San Gorgonio Pass near Palm Springs, California; efforts to shape policy in the federal courts; and finally back to Congress where several organizations tried to amend the policy in diverse ways. It appears as though national policy implementation must be relied on, even if it does introduce a degree of inefficiency. How might that process be altered to improve the quality of Section 210's implementation. The evidence presented in this paper suggests that these key changes deserve consideration. First, electric utilities should not be given major responsibility for implementing Section 210. Second, some form of public assistance should be provided to groups representing homeowners, small business people, and the owners of very small power production facilities. Third, agency administrators should explore innovative mechanisms of expanding the language and conceptual foundation of their deliberations. 41 references.

47979 **(DOE/BP—250) Generating resources supply curves.** 1 Jul 1984. 118p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE84017289.

This report documents Pacific Northwest supply curve information for both renewable and other generating resources. Resources are characterized as Renewable and Other as defined in Section 3 of the Pacific Northwest Electric Power Planning and Conservation Act. The following resources are described. Renewables are Cogeneration, Geothermal, Hydroelectric (New), Hydroelectric (Efficiency Improvement), Solar, and Wind. Other (non-renewable) generating resources are coal, combustion turbines, and nuclear. Each renewable resource has the following information documented in tabular format: (1) Technical Characteristics, (2) Costs (capital and O and M), (3) Energy Distribution by Month, and (4) Supply Forecast (both installed capacity and energy). The non-renewable resources have the same technical, cost, and operating characteristic information. The supply forecast for coal and combustion turbines is not limited for planning analyses. The generic nuclear resource is considered unavailable to the region over the planning horizon. The key differences between the September 1983 issue and this iteration are: (1) the addition of the hydroelectric (efficiency improvement) resource, and (2) the comprehensive revision of the wind resource projections.

47980 **(DOE/BP—307) Bonneville Power Administration forecasts of electricity consumption. Executive summary.** Jul 1984. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84017115.

This document presents a 20-year forecast of electricity consumption in the Pacific Northwest, for the years 1984 to 2004 for internal BNL planning needs. The forecast consists of high, medium, and low case scenarios. The medium projection is produced by merging the results from separate long-term and midterm forecasting models. The high and low projections were produced using the long-term forecasting models only. The long-term forecast is produced using a series of demand models in conjunction with an electricity supply pricing model. These models provide a detailed breakdown of energy use, but they are not, however, sensitive to monthly weather conditions, business cycles, or economic fluctuations which might prove significant in the near future. Midterm forecasting models are designed specifically to be responsive to such factors, allowing them to be captured in the final medium case load forecast which merges the long-term and midterm model results. These midterm models econometrically forecast monthly energy demand by state but without any detail by consuming sector.

47981 **(DOE/RA/50260—1) Research and development of a methodology for industry functional modeling.** (Scientific Systems, Inc., Cambridge, MA (USA)). Jul 1984. Contract AC01-80RA50260. 71p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85001915.

This report summarizes results of a three-year research effort to develop new methodologies and techniques for industry functional modeling. A body of theory and techniques have been developed under the general headings of polyhedral analysis and the dynamics of partially ordered systems. This work is described in some detail in the context of relational analysis, policy analysis, clustering theory, database design, the theory of the design of statistical experiments, and network reliability theory.

47982 (EPRI-EA—3637) **US housing stock and its energy-using characteristics: a data management system. Final report.** Aug 1984. 42p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920045.

The project Forecasting the Housing Stock and Its Energy Using Characteristics assembles diverse housing stock data and prepares it for further analysis. Significant data from six housing surveys were procured and processed to reside on a single coherent computer system. Three surveys examine structural traits of residential dwellings. Another three investigate appliance ownership, use, and energy consumption. While six data sets contain some socioeconomic information, two surveys draw close correlations between energy demand and socioeconomic factors. Yearly repetition of several surveys provide an historical perspective on the housing stock. Four successive years of the Annual Housing Survey were merged into one large, longitudinal file. A Data Management System (DMS) was designed to store the data cheaply, provide easy access, and offer utility programs for file manipulation and statistical analysis. Result of this project is a comprehensive housing stock data base which is easy to use and analyze. Two interactive programs control the data: FILETRAN and EPS, both of which perform calculations and analyses from single word commands.

47983 (EPRI-EA—3653-CCM) **User's guide to the Load Management Strategy Testing Model. Computer code manual.** Barrager, S.M.; Clark, C.E. Jr.; Fancher, R.B.; Shealy, M.; Stengel, D.N. Aug 1984. 409p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920010.

This document is a user's guide to Version 1.1 of the Load Management Strategy Testing Model (LMSTM). It is intended for both readers who wish to run the computer program as well as readers who wish to simply get an overview of the model and explanations about its output reports. The manual describes LMSTM's general structure and primary algorithms. It describes the model's output reports and input requirements and provides hints on the model's operation on a computer and its application in utility planning. The manual is accompanied by a Quick Guide to the LMSTM input set, which intended for use at a computer terminal.

47984 (EPRI-EA—3683) **Feasibility study: load data pool. Final report.** McDonald, C. Sep 1984. 171p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920003.

Establishing a national load research data pool would reduce the costs and time required for data collection and analysis. This study surveyed existing data, explored the feasibility of setting up such a pool, including utility interest in sharing and transferring data, and evaluated four design options.

47985 (NBS-SP—670, pp 61-70) **Introduction to the electric utilities subsystem.** Sanders, R. (Dept. of Energy, Washington, DC). Dec 1983. NTIS, PC A07/MF A01. File Number TI84017607. (CONF-8208201—).

From Symposium on the Department of Energy's intermediate future forecasting system; Washington, DC, USA (19 Aug 1982).

An explanation of the electric utilities Subsystem of the Intermediate Future Forecasting System (IFFS) is presented. Modularity is a design feature for the overall IFFS system. In the electricity market module this concept is extended to include a division of the module into four basic components. There is a planning component, a production costing or supply component, a pricing component, and a demand component. The interaction of these components can best be illustrated by following the information flows through the module. Input from other IFFS modules consists of electricity demand estimates and fuel prices. The planning module provides capital accounts to the pricing module and determines available capacity in the current forecast year for the production costing component. The production costing component allocates available generation capacity to satisfy electricity demands and tabulates the resulting operating cost and fuel consumption patterns. The pricing component combines the financial accounts from the planning component and the operating costs from the production costing component to produce an electricity price. The demand component adjusts the electricity demand to be consistent with the current electricity price estimate. Thus, an iterative cycle is established between the production costing, pricing, and demand components. This cycle terminates when electricity price and demand estimates remain constant through one full cycle. Output to the other IFFS modules consist of resulting fuel consumption patterns and electricity prices. 5 figures.

47986 (NBS-SP—670, pp 71-81) **Electric utilities subsystem: a critique.** Rubin, L.J. (Electric Power Research Inst., Palo Alto, CA). Dec 1983. NTIS, PC A07/MF A01. File Number TI84017607. (CONF-8208201—).

From Symposium on the Department of Energy's intermediate future forecasting system; Washington, DC, USA (19 Aug 1982).

The Intermediate Future Forecasting System (IFFS) is an integrated energy system model being developed by the Energy Information Administration (EIA) of DOE to use in forecasting and analysis over a medium-term horizon (8 to 10 years). Specific pieces of the energy system have been modeled individually and then linked together to form the integrated representation. This paper focuses exclusively on the electric utility module of the system, and attempts to review and critique the design and philosophy underlying it. For the most part, an understanding of the module design decisions and the principles underlying those decisions has been developed from the documentation provided by the modelers. Sample output reports have also been provided by the modelers, but these have been less useful as they are quite preliminary and the results are not particularly insightful. Also the modelers themselves have been questioned on certain specific issues, and their comments have helped to complete the information base necessary to this critique. Section II makes several general observations about the module, including underlying philosophy, purpose, and uses. Section III comments in depth on the underlying principle of decision-making - that of cost minimization - implicit in the module. Section IV addresses the production costing issue and its treatment in this module. Section V comments on the two principles of demand uncertainty and foresight in capacity planning, and attempts to point out potential difficulties with respect to their treatment in the design of the module. Finally, Section VI concludes by consolidating and summarizing the specific cautions and recommendations suggested to the modelers.

47987 (NP—24480) **Electric Utility Rate Design Study No. 97: analysis of methods for load shape response transfer. Final report.** (Charles River Associates, Inc., Boston, MA (USA)). Feb 1984. 179p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920514.

This report reviews a number of completed and ongoing research efforts dealing with the transfer of load response estimates for electric utility load management programs. Load response is defined as the change in load shape due to direct load control (DLC) or time-of-use (TOU) rate programs. Transfer refers to the use of data from one or more utilities (the donors) to predict response in another utility (the recipient). This report describes and evaluates both theory and practice for each transfer method, but it does not identify any best methodology. Most work in the area of load management response transfer has focused on TOU rate impacts rather than DLC program impacts. As a result, this report primarily reviews and evaluates methodologies developed to predict the impact of TOU rates. Only one DLC methodology, developed by Booz, Allen and Hamilton, was reviewed. In the TOU rate area, the primary methodologies evaluated were those developed by Aigner and Leamer, Christensen Associates, and Rand. The report concludes that the decision on whether or not the available transfer methodologies can accurately predict the impact of load management programs depends on the rigor of the standards of proof applied.

47988 (NP—24481) **Electric Utility Rate Design Study No. 95: customer attitudes and response to load management. Final report.** Lawrence, A.G.; Heberlein, T.A.; Baumgartner, R.M. Jul 1984. 192p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920515.

This report reviews customers' attitudes and responses toward load management programs conducted by electric utilities in the United States. Load management programs covered include direct load control and time-of-use pricing in both the residential and the commercial-industrial sectors. Customers' attitudes are disaggregated into three aspects: feelings, beliefs, and intentions. The evidence concerning each of these three aspects is presented and their interaction with each other is discussed. The report describes the marketing approaches and incentives associated with various load management programs and how they influence customers' participation rates. The linkage between attitudes, program design, and customer response is illustrated and discussed. A representative set of programs are individually described in an appendix.

47989 **(NUREG/CR—3929) Loss-of-benefits analysis for nuclear power plant shutdowns: methodology and illustrative case study.** Peerenboom, J.P.; Buehring, W.A.; Guziel, K.A. (Argonne National Lab., IL (USA)). Nov 1983. Contract W-31-109-ENG-38. 71p. (ANL/AA—29). NTIS, PC A04/MF A01 - GPO. File Number TI84017274.

A framework for loss-of-benefits analysis and a taxomony for identifying and categorizing the effects of nuclear power plant shutdowns or accidents are presented. The framework consists of three fundamental steps: (1) characterizing the shutdown; (2) identifying benefits lost as a result of the shutdown; and (3) quantifying effects. A decision analysis approach to regulatory decision making is presented that explicitly considers the loss of benefits. A case study of a hypothetical reactor shutdown illustrates one key loss of benefits: net replacement energy costs (i.e., change in production costs). Sensitivity studies investigate the responsiveness of case study results to changes in nuclear capacity factor, load growth, fuel price escalation, and discount rate. The effects of multiple reactor shutdowns on production costs are also described.

47990 **(ORNL/Sub—81-13846/1-06) New Industrial Park Energy Supply (NIPES): a method of efficiently supplying energy to a community of industrial users.** (United Engineers and Constructors, Inc., Philadelphia, PA (USA)). Aug 1984. Contract AC05-84OR21400. 333p. NTIS, PC A15/MF A01; 1; GPO Dep. File Number DE84016681.

The New Industrial Park Energy Supply (NIPES) concept allows the use of coal by small as well as large industrial users. The NIPES concept consists of a system of Energy Supply Stations groups of cogeneration plants) and steam transmission lines that supplies process heat and electricity to multiple existing and/or new users in an industrial park(s) setting. The Energy Supply Stations grow along with the industrial park(s) as new industries are attracted by a reliable reasonably priced energy source. The growth of the Energy Supply Stations over a period of years allows the introduction of new energy sources and technologies as they become established. This report describes the generic NIPES concept and the results of the evaluation of a specific NIPES system for the Lake Charles, Louisiana, area. A ten-year process steam load growth scenario is developed including both new and existing industrial users. During the initial years of the growth scenario, process steam is supplied to the industrial users by several coal-fired plants. Later, as the process steam load develops, a two-unit nuclear plant is integrated into the specific NIPES system. An evaluation is also performed for a NIPES system consisting of all coal-fired plants. The specific NIPES system is compared to: (1) individual user owned oil-fired facilities for existing industrial users; and (2) individual user owned coal-fired facilities for new industrial plants. A financial analysis is performed to determine the total economic advantages associated with the NIPES system: savings in a steam costs for industrial users, potential return on investment for investors.

47991 **(SCI—4015566) Decentralized energy technology integration assessment study. Second Principal Report.** (Systems Control, Inc., Palo Alto, CA (USA)). Dec 1980. 317p. NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE84015566.

This study addresses the integration of decentralized energy technologies (DETs) into future electric power systems. The principal objective is to gain a perspective on the potential benefits and problem areas that might arise in meeting future energy needs through a combination of conventional electric generating plants and small-scale, dispersed energy conversion devices. The utility viewpoint is important because many of the potential benefits of DET systems either derive from or are dependent upon an interaction between a DET and a utility system. A thorough evaluation of decentralized energy technologies should, therefore, consider the utility requirements for integration and also consider the impacts of integrating DETs into the utility system.

2980 Consumption And Utilization

REFER ALSO TO CITATION(S) 29800048449

47992 **(AD-A—141728/6) Effect of aggregation in nonlinear regression. Technical summary report.** Goldberg, M.L. (Wisconsin Univ., Madison (USA). Mathematics Research Center). Apr 1984. 41p. (MRC-TSR—2669). NTIS, PC A03/MF A01.

It is often convenient to apply a nonlinear model developed for a single unit to data representing the average response for several units. The relationship between the parameters of the aggregate model and those of the individual units is investigated in a geometrical framework, for a general nonlinear model. The aggregation effect derived is closely related to the bias in nonlinear estimation, as given by Box. Unlike the bias, however, the aggregation effect may be of comparable magnitude to the standard error of the estimates. The theoretical results derived are verified empirically in an application to a model of residential energy consumption.

47993 **(CONF-8403138—1) Residential demand for electricity: a technology-based forecasting method.** Asbury, J.G. (Argonne National Lab., IL (USA)). 16 Mar 1984. Contract W-31-109-ENG-38. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84014728.

From Workshop on electricity demand forecasting residential sector models; Washington, DC, USA (16 Mar 1984).

In this paper we describe the application of the technology-based method to the residential sector. The residential sector now accounts for about one-third of total electricity consumption in the United States. Within this sector, electricity powers a heterogenous set of small and major appliances and, as indicated by the growing seasonal variation in monthly consumption levels, is finding ever greater use in space heating and space cooling applications. Because of the many and varied uses of electricity in the residential sector and because of the associated data requirements, application of the method at the national level necessarily involves many approximations and simplifying assumptions. Because of the region-specific nature of heating and cooling loads and the strong regional variations in competing-fuel prices, the method is more reliably applied at the regional or service-area level for which more detailed market data can be acquired.

47994 **(EPRI-EA—3604) Aggregrate consumer expenditures on energy. Final report.** Jorgenson, D.W. Aug 1984. 325p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920035.

This report presents a new economic model for the allocation of aggregate consumer expenditures on energy in the United States. Our model is based on a theory of consumer behavior involving two stages. In the first stage total expenditures are allocated between and nonenergy commodities. Allocation depends on the price of energy, prices of all nonenergy commodities, and the level of total expenditure. Total energy expenditure in the second stage is allocated among individual types of energy. The second stage allocation depends on the prices of individual types of energy and the level of total energy expenditure. Our econometric model can be applied to the generation of projection of aggregrate energy demand in the United States. Projected future energy prices, the future level and distribution of total energy expenditure, and the future demographic development of the population for projections. The model can also be used to make projections for individual consumer groups within the United States, classified by total energy expenditure and by demographic characteristics. Finally, it can be integrated into a model of energy and nonenergy expenditures to provide a complete model of aggregate consumer behavior. Our econometric model of aggregate consumer behavior can be applied to the generation of projection of demand individual types of energy and for all nonenergy commodities in the United States.

47995 (NP—4901851) 1982-83 annual energy report. North Carolina Energy Policy Council. 15 Apr 1984. 35p. North Carolina Dept. of Commerce, Energy Div., 430 N. Salisbury St., Raleigh, NC 27611. File Number TI84901851.

This report describes the total energy picture in North Carolina. The next few years are quite likely to see continued moderation in oil price increases as the large current excess of OPEC capacity reduces the odds for any major disruption. Natural gas prices, while recently showing stubborn upward momentum in the face of softening oil prices, are now likely to moderate considerably. Natural gas price growth for the next few years should not be seriously different from the moderate growth expected for oil. Moderate growth in these key fuel prices, as well as more moderate growth in electricity prices, should be positive factors for both the national and North Carolina economies in the next few years. Several notable differences for North Carolina are: The proportion of electricity which is based on coal generation is considerably above the national average. This currently provides an electricity price advantage as compared with the US average. The major electric utilities serving North Carolina have several nuclear plants under construction which should ensure more than adequate supplies of power for a substantial period. This assurance, plus a slight cost advantage, should provide an incentive for encouraging industrial development in the state. In summary, both the state and the nation are likely to benefit from the absence of major energy price shocks for the next few years. Before the late 1980s, however, the potential for oil disruptions and further price shocks begins to increase considerably. North Carolina has made significant progress over the last ten years to become less energy intensive. The historical data and forecast data show moderate growth in total energy consumption. Also, the forecast proves that North Carolina, as a net importer of energy, can become less dependent on outside sources of energy through strong programs in the areas of alternative energy, energy conservation and load management.

47996 (TVA/OP/ECR—83/58) Electric bill for commercial, industrial and institutional users. 1983. 10p. NTIS, PC A02/MF A01. File Number DE84901498.

This brochure explains how electrical use is measured and priced and is intended primarily for commercial, industrial and institutional establishments in the TVA service area. Rate schedules and billing provisions such as power service contracts and minimum bills are also discussed, and basic information on reading demand meters and tracking electricity use is included. Specific ways to increase energy efficiency may also be explored through onsite energy surveys offered through electric power distributors and TVA. This service includes advice on cost-effective load management and solar applications. Loans are also available through TVA to help implement certain energy-saving measures.

2990 Unconventional Sources And Power Generation

REFER ALSO TO CITATION(S) 29900047580, 47585, 47588, 47595, 47629, 47632, 47655, 47950, 47991, 47991

47997 (DOE/CH/10122—22) Midwest Appropriate Technology Small Grants Program technical services. Final report. Mar 1984. Contract AC02-82CH10122. 22p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84009449.

A total of 84 completed projects were reviewed, assessed, and summarized. These projects were also analyzed to determine characteristics of success and failure. Two significant documents resulted: Midwest ATSGP Project Summaries (DOE/CH/10122-19) and Midwest ATSGP Management Analysis (DOE/CH/10122-18). Additionally, 17 active projects were monitored. All grantees were contacted by telephone and 15 sites were visited. Technical assistance was provided to seven of the active grantees. Three grantees were found to be having serious difficulty. Information dissemination activities were limited at DOE-Chicago direction. Presentations at a meeting of state energy agency representatives and the American Solar Energy Society annual meeting were the highlights. Overall, DOE-Chicago was provided important assistance and documentation on the Midwest ATSGP. In addition, several grantees were assisted in the conduct of their project. A complete timetable of activities is included as Appendix E.

47998 (DOE/OR/21390—T1) Great Lakes Regional Biomass Energy Program. Regional biomass needs and priorities assessment: survey results. May 1984. Contract FG05-83OR21390. 236p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE84017296.

The results of 3 surveys conducted in the Great Lakes Region (Illinois, Indiana, Iowa, Michigan, Minnesota, Ohio, and Wisconsin) covering feedstock production and harvesting, and fuel production and conversion of biomass are presented. These survey results will be used to develop regional biomass assessments to define long-range program objectives. The goals of the program include: (1) assessing the availability of biomass resources for energy in light of other competing needs and uses; (2) encouraging private sector investments in biomass energy technologies; (3) transferring to the private sector the results of biomass research and development; (4) eliminating or reducing barriers to private sector use of biomass fuels and technologies; and (5) preventing or substantially mitigating adverse environmental impacts of biomass energy use. Numerous figures.

47999 Marketing opportunities in the photovoltaic industry. Hearing before the Subcommittee on Energy, Environment, and Safety Issues Affecting Small Business of the Committee on Small Business, House of Representatives, Ninety-Seventh Congress, Second Session, December 9, 1982. Washington, DC, USA; Government Printing Office (1983). 20p.

This report deals with the photovoltaic industry and the role government plays in the PV market, both here in the US and abroad. The drastic budget cuts in the PV research and development program at the Department of Energy have set back several promising technologies and threaten to give our foreign competitors a technological edge. There is a substantial demand for PV equipment in developing countries for irrigation, communications, refrigeration, and small-scale electrical generation. Testimonies are included from various members of the PV industry, relating their experiences marketing renewable energy technologies abroad.

30 DIRECT ENERGY CONVERSION

3001 Mhd Generators

48000 (DOE/ET/10815—95) Direct coal-fired MHD power systems. Quarterly technical progress report, October-December 1983. (Tennessee Univ., Tullahoma (USA). Space Inst.). Sep 1984. Contract AC02-79ET10815. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE84016346.

Progress is reported on the addition of components to the MHD test train in the CFFF and the analysis of data from the previous test series, designated LMF1. No testing was scheduled this quarter. Action was initiated to install the superheater test module and low temperature air heater. At the end of the quarter, all components were delivered on site and installed in place with the exception of one water-cooled section and the 180° elbow. The contract was awarded to install refractory on these components upgrading the refractory to a temperature rating of 2900°F to permit testing with higher gas temperatures. A cold flow modeling effort for these components was also initiated to assist in data analysis of test results. Comments received from reviewers on the design report for the baghouse were resolved and procurement will be initiated on this component next quarter. Concurrently computer modeling of the electrostatic precipitator performance was initiated in preparation for finalizing the specifications for this component. Data analysis and modeling efforts are reported for the combustor, radiant furnace, materials test module, high pressure test sections and the nonintrusive diagnostic systems.

48001 **(DOE/ET/10815—99) Theoretical study of compressible two phase internal flow.** Hwang, C.J. (Tennessee Univ., Tullahoma (USA). Space Inst.). Aug 1984. Contract AC02-79ET10815. 119p. NTIS, PC A06/MF A01; GPO Dep. File Number DE85001603.

Thesis. Submitted to Univ. of Tennessee, Knoxville.

A numerical solution procedure has been developed for solving one phase, gas-only flow or fully coupled, gas-particle two phase flow in axisymmetric or two-dimensional geometries. The numerical basis of the present research is a time-dependent, unsplit, explicit, second-order accurate MacCormack finite difference scheme. Some special numerical techniques are developed to ensure numerical stability. The finite difference scheme has been used to solve the Navier-Stokes equations for the interior of the flow domain and an integral method is incorporated into this program to treat the turbulent boundary layer regimes. In order to evaluate the program, the results are compared to physical phenomena and evaluated on the basis of basic physical principles. The purpose of the present work is to serve as a method for predicting both one and two phase flow in nozzles, especially those of solid fueled rocket motors. However, it is the primary objective of the present study to investigate the behavior of one and two phase flow passing through the combustor outlet, nozzle, and channel inlet of the Coal Fired Flow Facility, which is an MHD power generation system being developed at The University of Tennessee Space Institute for the United States Department of Energy. The results of the study indicate the level of gas-particle coupling in flow acceleration devices such as nozzles, and the differences that can be expected between two phase and single phase gas flows. 48 references.

48002 **Magnetohydrodynamic generator scaling analysis for baseload commercial power plants.** Swallom, D.W.; Pian, C.C.P. (Avco Everett Research Lab., Everett, MA). *Journal of Energy;* 7: 338-344(Jul 1983). Contract AC22-80ET15614.

Previously cited in issue 06, p. 899, Accession no. A82-17922.

48003 **Simulation of starting transients in the UTSI MHD generator.** Liao, Y.F.; Schmidt, H.J. (Tennessee Univ., Tullahoma). *Journal of Energy;* 7: 374-381(Jul 1983). Contract AC02-79ET10815.

Previously cited in issue 15, p. 2434, Accession no. A82-31910.

3005 Fuel Cells

48004 **(DOE/ET/15440—5) Development of molten carbonate fuel cell power plant technology. Quarterly technical progress report No. 5, October 1, 1980-December 31, 1980.** (United Technologies Corp., South Windsor, CT (USA). Power Systems Div.). 1980. Contract AC02-79ET15440. 81p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85001783.

The overall objective of this program is to develop and verify the design of a prototype molten carbonate fuel cell stack which meets the requirements of a 1990's-competitive coal-fired electrical utility central station or industrial cogeneratin power plants. During this quarter, activity continued in all four task areas: Task 1 - system studies to define the reference power plant design; Task 2 - cell and stack design, development and verification; Task 3 - preparation for fabrication and testing of the full-scale prototype stack; and Task 4 - development of the capability to operate stacks on coal-derived gas.

48005 **(DOE/ET/15440—8) Development of molten carbonate fuel cell power plant technology. Quarterly technical progress report No. 8, July 1, 1981-September 30, 1981.** (United Technologies Corp., South Windsor, CT (USA). Power Systems Div.). 1981. Contract AC02-79ET15440. 95p. (FCR—3765). NTIS, PC A05/MF A01; GPO Dep. File Number DE85001784.

The overall objective of this 19-month program is to develop and verify the design of a prototype molten carbonate fuel cell stack which meets the requirements of a 1990's-competitive coal-fired electrical utility central station or industrial cogeneration power plants. During this quarter, activity continued in all four task areas: Task 1 - system studies to define the reference power plant design; Task 2 - cell and stack design, development and verification; Task 3 - preparation for fabrication and testing of the full-scale prototype stack; and Task 4 - development of the cability to operate stacks on coal-derived gas. Progress is reported.

48006 **(DOE/ET/15440—T4) Development of molten carbonate fuel cell power plant technology. Quarterly technical progress report No. 10, January 1-March 31, 1982.** (United Technologies Corp., South Windsor, CT (USA). Power Systems Div.). Apr 1982. Contract AC02-79ET15440. 56p. (FCR—4267). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85001786.

The overall objective of this 35 month program is to develop and verify the design of a prototype molten carbonate fuel cell stack which meets the requirements of a 1990's-competitive coal-fired electrical utility central station or industrial cogeneration power plants. During this quarter, activity continued in Task 2 - Cell and Stack Design, Development, and Verification. Progress is reported. Work in Tasks 1, 3 and 4 has been constrained in accordance with contract Modification No. 007.

48007 **(DOE/ET/17089—5) High-temperature, solid oxide electrolyte fuel cell power generating system. Annual report, June 1, 1980-May 31, 1981.** (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). 14 Oct 1981. Contract AC02-80ET17089. 114p. NTIS, PC A06/MF A01; GPO Dep. File Number DE84016278.

Closed-end tubes are now being prepared in-house, for use in fabricating and evaluating the FBA cell design. New perovskite-type mixed oxides are being investigated as air electrode materials and some have been identified and are being used in FBA cell test evaluation studies. Initial FBA cells have been fabricated and tested. Although their performance is below target goals, fabrication procedures for all fuel cell components have been verified for cell construction. Areas of investigation for FBA cell performance improvement have been identified and work is proceeding in these areas. Variable-length cells in the series-cell stack design have demonstrated high (85%) fuel utilization with good performance (0.57 anti V at 400 mA/cm^2 average, simulated coal derived fuel, 1000°C).

48008 **(FCR—4031) Development of molten carbonate fuel cell power plant technology. Quarterly technical progress report No. 9, October 1, 1981-December 31, 1981.** (United Technologies Corp., South Windsor, CT (USA). Power Systems Div.). 1981. Contract AC02-79ET15440. 67p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85001785.

The overall objective of this 29-month program is to develop and verify the design of a prototype molten carbonate fuel cell stack which meets the requirements of a 1990's-competitive coal-fired electrical utility central station or industrial cogeneration power plants. During this quarter, activity continued in three of the four task areas: Task 2-cell and stack design, development and verification; Task 3 - preparation for fabrication and testing of the full-scale prototype stack; and Task 4 - development of the capability to operate stacks on coal-derived gas. Progress is reported. (WHK)

48009 **(FCR—6262F) Phosphoric and electric utility fuel cell technology development. Technical progress report No. 11, for quarter ending March 1984.** Breault, R.D.; Briggs, T.A.; Congdon, J.V.; DeMarche, T.E.; Gelting, R.L.; Goller, G.J.; Luoma, W.L.; McCloskey, M.W.; Mientek, A.P.; O'Brien, J.J. (United Technologies Corp., South Windsor, CT (USA). Power Systems Div.). 1984. Contract AC21-83FE60338. 76p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85001341.

The Department of Energy has initiated this program to advance electric utility cell stack technology and to reduce cell stack cost. The cell stack has a nominal 10-ft^2 active area and operates at 120 psia/405°F. The program comprises six parallel phases, which culminate in a full-height, 10-ft^2 stack verification test: Phase I provides the information and services needed to manage the effort, including definition of the prototype commercial power plant; Phase II develops the technical base for long-term improvements to the cell stack; Phase II develops materials and processing techniques for cell stack components incorporating the best available technology; Phase IV provides the design of hardware and conceptual processing layouts, and updates the power plant definition of Phase I to reflect the results of Phases II and III; Phase V manufactures the hardware to verify the achievements of Phases II and III, and analyzes the cost of this hardware; and Phase VI tests the cell stacks assembled from the hardware of Phase V to assess the state of development. Progress is reported.

48010 **(MHD-III—84-073) Coal-Fired MHD Combustor Development Project: Phase IIID. First quarterly technical progress report.** (TRW Energy Development Group, Redondo Beach, CA (USA)). 20 Aug 1984. Contract AC22-84PC70508. 57p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE84017228.

This is a new contract start for the MHD Combustor Development Project and represents a continuation (Phase IIID) of the 50 MW/sub t/ coal-fired combustor development work. The scope of work covered by this quarterly report relates to those tasks associated with the Design Verification Testing of the 50 MW/sub t/ combustor, the technical support of the CDIF preparation activities and the fabrication of the second 50 MW/sub t/ combustor first stage unit. Progress during this reporting period is reported. All testing on the 50 MW/sub t/ combustor first stage was completed on 14 July 1984. A total of 31 tests were conducted. The combustor first stage assembly and associated hardware was delivered to CDIF on 30 July 1984. Fabrication of the second first stage unit was initiated and was 65% completed during this quarter. Coordination with CDIF activities was continued and a combustor User's Manual and Detail Test Plan were prepared by TRW and submitted to MSE and DOE/PETC for review and comments.

48011 **(N—84-23023) Design considerations for a 10-kW integrated hydrogen-oxygen regenerative fuel cell system.** Hoberecht, M.A.; Miller, T.B.; Rieker, L.L.; Gonzalez-Sanabria, O.D. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1984. 13p. (NASA-TM—83664; E—2041). NTIS, PC A02/MF A01.

Integration of an alkaline fuel cell subsystem with an alkaline electrolysis subsystem to form a regenerative fuel cell (RFC) system for low earth orbit (LEO) applications characterized by relatively high overall round trip electrical efficiency, long life, and high reliability is possible with present state of the art technology. A hypothetical 10 kW system computer modeled and studied based on data from ongoing contractual efforts in both the alkaline fuel cell and alkaline water electrolysis areas. The alkaline fuel cell technology is under development utilizing advanced cell components and standard Shuttle Orbiter system hardware. The alkaline electrolysis technology uses a static water vapor feed technique and scaled up cell hardware is developed. The computer aided study of the performance, operating, and design parameters of the hypothetical system is addressed.

48012 **(NMAB—411) Fuel cell materials technology in vehicular propulsion.** (National Materials Advisory Board (NRC), Washington, DC (USA)). 1983. Contract AC01-78ET26946. 196p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85000734.

The Committee on Fuel Cell Materials Technology in Vehicular Propulsion focused on technological limitations, especially materials and electrochemical limitations, that need to be resolved. The fuel cell systems evaluated include those based on acid, polymer, alkaline, solid oxide, and molten carbonate electrolytes. Consideration was given to compatibility between these fuel cells and logistic fuels, including petroleum derivatives, synthetic hydrocarbons from coal and shale, and hydrogen from nuclear energy. Applications included consumer vehicles, delivery vans, city buses, trucks, locomotives, and push-tow boats. These transportation applications are all different from space and stationary power applications, which to date have been the major areas of fuel cell research and development. Because about half of the petroleum consumed in the United States is for transportation, and because fuel cells are more fuel-efficient and more pollution-free than internal combustion engines, it is in the national interest to pursue the evaluation of fuel cell systems for vehicle applications. The greatest impact will be in the passenger vehicle market, for which current fuel cell systems are not adequate. Challenging scientific and engineering tasks need to be addressed through research and development. The application of fuel cells to transportation represents a high-risk, long-term research endeavor that would benefit from focused federal support. Summarized in this report are research and development activities that, if pursued successfully, would bring fuel cell performance to a level suitable for transportation applications. These activities cover a span from engineering development to long-range scientific endeavor, and they require joint cooperative efforts between industrial, governmental, and university research personnel. References.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

48013 **(BNL—51748) Energy efficiency and conservation in West Africa.** (Brookhaven National Lab., Upton, NY (USA)). 1983. Contract AC02-76CH00016. 320p. (CONF-830365—). NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE84017244.

From Seminar on energy efficiency and conservation; Lome, Togo, Africa (30 Mar 1983).

Separate abstracts were prepared for individual papers. (MHR)

48014 **(PNL—5223) ECORLOG computer application users' and programmers' guides.** Winter, C. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1984. Contract AC06-76RL01830. 132p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE84017275.

This document consists of two separate guides to the ECORLOG application. Sections One through Five make up the Users' Guide, while the Programmers' Guide is contained in the Appendix. The Programmers' Guide contains information that will be useful in maintaining or updating the ECORLOG application's capabilities, but is not needed for day-to-day use of the ECORLOG Job and programs. Each of the following four sections covers a separate aspect of ECORLOG. Section Two explains how data is entered into a Batch of the ECORLOG Job. In Section Three, several common data-editing operations are described. Instructions for running the three ECORLOG programs (ECORUP, ECRPT1 and ECRPT2) are given in Section Four, which also includes samples of the ECORLOG reports. Section Five concludes the Users' Guide with procedures for redirecting the output of ECORLOG reports to different printers, and for storing ECORLOG data at the end of a fiscal year.

3201 Buildings

REFER ALSO TO CITATION(S) 32010047896, 47921, 47982, 48122, 48132, 48519

48015 **(AD-A—141878/9) EMCS (Energy Monitoring and Control Systems) Installation Follow-Up study. Volume I. Final report April 1983-March 1984.** Bruning, S. Mar 1984. 54p. NTIS, PC A04/MF A01.

See also Volume 2, AD-A141879.

This report provides the Task 3 deliverables for an EMCS Installation Follow-Up study. The objective of this study is to provide data on experience at existing EMCS installations for use in developing guidelines for better implementation of EMCS. Section 2.0 of this report provides a list of probable causes for EMCS success/failure identified in previous studies. Section 3.0 discusses whether or not recommendations made in the Kings Bay study have been implemented and how effective those actions have been in addition to discussing areas not previously addressed. Section 4.0 provides a summary list of recommendations which are based on current conditions as found during the course of this project. Section 5.0 provides Exhibits referenced in Section 1.0 through 4.0. All Appendices are bound separately as Volume II of this report.

48016 (AD-A—141879/7) **EMCS (Energy Monitoring and Control Systems) Installation Follow-Up study. Volume II. Final report April 1983-March 1984.** Bruning, S. Mar 1984. 54p. NTIS, PC A04/MF A01.

See also Volume 1, AD-A141878.

This report contains the site visit reports of all the sites visited in the Kings Bay Master Plan/Feasibility Study for implementing EMCS and follow-on visits.

48017 (BNL—51765) **Monitoring building energy performance. An informal review and characterization of research in progress.** Mar 1984. Contract AC02-76CH00016. 78p. NTIS, PC A05/MF A01; GPO Dep. File Number DE84017181.

Individual projects and programs are summarized in a series of one-page abstracts. These projects have been assigned arbitrary reference numbers, which appear in the reference tables. A project may appear in more than one reference category. (MHR)

48018 (CONF-840919—1) **Utility weatherization programs.** Kier, P.H. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84017468.

From 4. biennial NARUC regulatory information conference; Columbus, OH, USA (5 Sep 1984).

Public utility commissions (PUCs) have recently ordered or approved an increasing number of programs that install weatherization measures in residences. These programs tend to install only low-cost weatherization measures (e.g., caulking, weatherstripping, plastic storm windows, door sweeps) or major weatherization measures (e.g., insulation, storm windows, storm doors). When a program does not have income restrictions for eligibility, part of the costs are paid by the participating customer. For programs that install low-cost measures, the participant usually pays at the time of installation for the measures chosen. To require payment for major weatherization measures at the time of installation could deter participation, so these programs usually provide loans with the interest subsidized by the sponsor. Low-income customers, who have little or no disposable income, tend to shun Residential Conservation Service, loan, and other utility conservation programs that have costs to participants. Therefore PUCs have turned to programs that install weatherization measures without charge in order to reach low-income customers. This paper discusses some of the regulatory issues raised by these programs and how they have been justified by PUCs. It also gives information on cost and energy savings for 10 weatherization programs, both utility-sponsored and non-utility-sponsored, and attempts to interpret this information.

48019 (DOE/CS/69105—4) **Window coverings.** 1981. Contract FG02-80CS69105. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84017580.

This brochure discusses the following: how heat loss and gain occurs, moisture problems, conventional coverings seldom save energy, plastic window sheets, insulated window coverings, and what to look for. (MHR)

48020 (DOE/SF/10856—T1) **Installation guidelines for electrically operated automatic vent or chimney connector dampers for use with oil-fired central furnaces and low-pressure hot-water boilers. Final report.** (Hittman Associates, Inc., Columbia, MD (USA)). 10 Dec 1980. Contract AC03-80SF10856. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE84016527.

The scope, pre-installation inspection procedure, general installation procedure, post-installation inspection procedure, inspector's checklist, and justification for installation guidelines are outlined in detail. (MHR)

48021 (EGG-M—09784) **Available energy method for evaluating thermodynamic performance of heat pump systems.** Bliem, C.J.; Demuth, O.J.; Richlen, S.L. (EG and G Idaho, Inc., Idaho Falls (USA)). 30 Mar 1984. Contract AC07-76ID01570. 21p. (CONF-840804—49). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84017223.

From Intersociety energy conversion engineering conference; San Francisco, CA, USA (19 Aug 1984).

An available-energy-efficiency method, based on the Second Law of Thermodynamics, is developed for the evaluation and comparison of the thermodynamic performance of different types of heat pump systems. Deficiencies and limitations of the more commonly used performance indicators, coefficient of performance and fraction of Carnot cycle coefficient of performance, are discussed. Finally, several heat pumps of different types are evaluated and compared in terms of available-energy efficiency as examples of the application of the method.

48022 (LBL—17055) **Residential conservation data base for the Pacific Northwest. Final report.** Usibelli, A.; Gardiner, W.; Luhrsen, W.; Meier, A. (Lawrence Berkeley Lab., CA (USA)). Nov 1983. Contract AC03-76SF00098. 65p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85001921.

This report describes and documents a data base of residential electricity conservation measures for the Pacific Northwest and a computer program to manage the data base. In addition, the computer program can aggregate these measures and present region-wide potentials for energy conservation in the form of supply curves of conserved energy. The Bonneville Power Administration (BPA) forecast of residential sector demand in the year 2000 of 7728 average megawatts, could be reduced 42% to approximately 4447 average megawatts if all technically feasible conservation measures costing less than 150 mills were implemented. 87% of the potential savings can be realized at a cost of 40 mills or less. 84 references, 10 tables, 5 figures.

48023 (LBL—18126) **Peak demand savings from daylighting in commercial buildings.** Selkowitz, S.; Arasteh, D.; Johnson, R. (Lawrence Berkeley Lab., CA (USA)). Jul 1984. Contract AC03-76SF00098. 24p. (CONF-840819—10). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84016880.

From Doing better: setting an agenda for the second decade; Santa Cruz, CA, USA (14 Aug 1984).

In many regions in the US, load management and peak demand issues are of greater importance to utility planners than are reductions in energy consumption. Proper daylight utilization in commercial buildings can substantially reduce peak demand and increase energy savings. However, to determine optimum design strategies for controlling electrical demand, it is first necessary to understand the often conflicting impacts of fenestration on lighting and cooling loads. We use an hour-by-hour energy simulation model (DOE-2.1B) to evaluate peak demand components and net effects in daylighted and nondaylighted buildings. More than 5000 parametric simulations were generated for prototypical office building modules containing both horizontal and vertical glazing, and located in 16 US cities. From these simulations we draw conclusions about the effects of daylighting on peak demand for a range of climate types, orientations, fenestration areas, glazing shading coefficients and visible transmittances, U-values, lighting power densities, and lighting control strategies. Results for Los Angeles are briefly compared to results for the climatic extremes of Lake Charles, Louisiana (cooling-dominated), and Madison, Wisconsin (heating-dominated), and then discussed in detail. We also briefly describe studies in progress to measure peak load impacts of fenestration using an outdoor test facility and occupied buildings.

48024 (NP—4901876) **Geothermal groundwater heat pump. Equipment selection procedures for architects, designers and contractors.** 1981. 29p. South Dakota Office of Energy Policy, State Capital Street, Pierre, SD. File Number TI84901876.

This brochure covers the following: the way the heat pump works, why use groundwater, groundwater availability and disposal, regulations, the coefficient of performance, heat pump maintenance and reliability, heating and cooling load calculations, fuel requirement calculations, choice of equipment, calculation of water flow requirement, well pump and supply/return pipes, and design examples. (MHR)

48025 (NYSERDA—84-11) **Business Guide to energy performance contracting. Final report.** May 1984. 61p. NYSERDA, Two Rockefeller Plaza, Albany, NY 12223. File Number TI84901478.

This Business Guide will assist property owners to understand what an energy performance contract is and how to enter into one. Energy performance contracts are defined and compared to the conventional fixed fee approach to achieving energy efficiency. The various forms of energy performance contracts (installment purchase, lease, shared savings, and energy services) are described with advantages and disadvantages of each pointed out. The reader is then taken through a step-by-step discussion of how to solicit and evaluate proposals and how to negotiate and implement an energy performance contract.

48026 (NYSERDA—84-12) **Flue gas condensate disposal from high-efficiency oil-fired furnaces. Final report.** Stickford, G.H. Jr. (Battelle Columbus Labs., OH (USA)). Sep 1983. 61p. NYSERDA, Two Rockefeller Plaza, Albany, NY 12223. File Number TI84901830.

The results of an investigation on the disposal of flue-gas condensate from condensing oil-fired heating systems are presented. The condensate from oil-fired systems is more acidic than that from gas-fired systems, presenting a greater concern about both heating system and drain line corrosion. The use of condensing-type furnaces for residential space heating offers energy advantages because of their increased efficiency. However, the reduced temperature for exiting combustion products produces 5 to 10 gallons of acidic liquid a day in a typical residence. Under normal conditions, the residential sanitary drain generates 30 to 60 gallons of effluent. The investigation looked at whether there were any negative effects from the added acid to drains and municipal sewage treatment systems. It was concluded that under normal flushing conditions ferrous drain materials increased corrosion by 10 percent, but that the condensate disposal was found to have little or no increased corrosive effect on copper, lead or solder materials. Also, acid-resistant and regular mortar exposed to flue-gas condensate in sanitary drains experienced no major degradation after one heating season. More study is needed for residential homes that are heated but not lived in for long periods of time. Geographic effects on drain corrosion are indicated also. Water systems in some parts of Long Island, New York City and Utica lack buffering qualities and hence make it more difficult to neutralize the condensate. In the remaining cities of New York State one may expect significantly less corrosion due to condensate addition in the drain because the neutralizing capacity of the water is 3 to 5 times greater.

48027 (ORNL/Sub—81-61615/1) **Gas space heating equipment modifications.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC; Oak Ridge National Lab., TN (USA)). Jun 1981. Contract AC05-84OR21400. 134p. NTIS, PC A07/MF A01; GPO Dep. File Number DE84016642.

This brochure covers the following: gas supply fundamentals, gas combustion fundamentals, heat transfer and venting fundamentals, basic electricity review, basic heating system control components, gas space heating systems, and energy conservation components. (MHR)

48028 (PB—84-207430) **Storage of cold house air-conditioning.** Kihlblom, U.; Hyden, H.; Kellner, J.; Matsson, L.O. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1984. 56p. (D—12:1984). NTIS, PC A04/MF A01.

Seasonal storage of energy in the ground has a large potential in a wide variety of applications. This report deals with seasonal storage of cold in drillhole storages in the bedrock (Sunstore storages) for air-conditioning of houses in hot climates.

48029 (TVA/OP/EDT—84/34) **Performance and scaling evaluation of water-spray augmentation of air-cooled condensers. Parts I and II.** Guinn, G.R.; Jordan, M.; Wallace, D.; Hummer, L. Mar 1984. 281p. NTIS, PC A13/MF A01. File Number DE84901973.

The results of two projects involving the augmentation of air conditioning condensers with water sprays are described. Techniques for mitigating scaling and corrosion effects on the coil surfaces were evaluated. Effectiveness was determined by comparing five condensing units subjected to long-term exposure of water sprays conditioned by various water treatment techniques. The testing was conducted in an environmental chamber which was capable of maintaining summertime ambient conditions throughout the year. Exposure was long enough for the control unit (no water conditioning employed) to experience significant scale buildup on the surfaces of the condenser. Results indicated that several conditioning techniques provide considerable protection from scale buildup and corrosion. The most effective were deionization, zeolite softening, and silicone coating. Field evaluation of a commercially available spray device was done on the air conditioner of a typical residence. The results indicated that a spray tends to decouple the electrical consumption and demand from ambient air temperature. This resulted in a reduction in the average daily demand of 8.7 percent, and it was estimated that the peak demand was reduced by 16 percent.

48030 (WAOENG—84-30) **Model Conservation Standards for commercial buildings.** 1984. 301p. NTIS, PC A14; 3; GPO Dep. File Number DE84017117.

An introduction and overview of the Model Conservation Standards (MCS) are presented. MCS definitions, design requirements, component performance approach, energy budgets approach, and the comparison of MCS and 1980 state energy code are included. (MHR)

48031 **Spokane Energy Resource Center.** Reichelderfer, S. *WSEO Newsletter;* 7: No. 5, 5-6(Sep 1984).

A brief description is given of the programs of the Spokane Energy Resource Center during 1983-84. The Center, an energy education program of the Spokane Regional Council, is partially funded by the Bonneville Power Administration and the US Department of Energy through the Washington State Energy Office. During the program year the ERC concentrated on five major program areas: new residential construction, residential retrofits and remodels, low-income home improvements, commercial sector conservation, and irrigation energy improvements. The greatest amount of service was provided to the residential sector.

48032 **Change mechanisms in the diffusion of residential energy conservation practices: an empirical study.** Brown, M.A. (Univ. of Illinois, Urbana, IL). *Technological Forecasting and Social Change;* 2: No. 2, 123-138(Apr 1984).

Four types of variables that affect the diffusion of home energy conservation measures are assessed. These variables are the information possessed by households, household attitudes, the economic and demographic characteristics of households, and the attributes of conservation measures. A casual model of behavior change is presented based on Fishbein's theory of reasoned action. The model is tested using panel data on 225 homeowners from Decatur, Illinois and two conservation practices: employing winter night-time thermostat setbacks and adding attic insulation. The results illustrate the importance of all four change mechanisms. Many nonadopters have erroneous information about the financial and other benefits of the two practices. The elderly and the poor are particularly ill-informed. Negative attitudes are closely related to discomfort (for night-time setback) and expense (for attic insulation). As expected, barriers and incentives differ across population subgroups and innovations.

48033 **Natural ventilation: It's as easy as opening the windows, or is it?.** Siebein, G.W. (Univ. of Florida, Gainesville, FL). *Alternative Energy Sources;* 109-110(Dec 1983). (CONF-831205—).

From 6. Miami international conference on alternative energy sources; Miami Beach, FL, USA (12 Dec 1983).

This research was conducted as part of a Faculty Summer Appointment at the Battelle Pacific Northwest Laboratory through NORCUS and the D.O.E. The research consisted of four basic components: 1. An analysis of several national building surveys was undertaken to examine the potential for using natural ventilation as a means of cooling within the existing usage patterns and non-residential building stock of the U.S. 2. An extensive literature search was undertaken to identify nonresidential buildings that have been built and operated in recent years using natural ventilation as a cooling strategy. 3. A series of interviews were held with architects, engineers, building owners and operators to outline the perceptions of these groups as to the advantages and obstacles involved with the use of natural ventilation in buildings today. 4. More detailed case studies were conducted of two highly successful buildings (Quincy Market, Boston, Massachusetts, and the Terman Engineering Center, Stanford University, Stanford, California) to underline the potential for user acceptance of natural ventilation despite the many misconceptions that prevail at the present time in the marketplace.

48034 **Passive solar strategies as a logic for improved architectural design: Two prototypes for modular housing.** Reeder, B.C. (Archetype, Washington, DC). *Alternative Energy Sources;* 103(Dec 1983). (CONF-831205—).

From 6. Miami international conference on alternative energy sources; Miami Beach, FL, USA (12 Dec 1983).

This paper presents a project in which two passive solar housing prototypes were developed for mass production as modular housing. The prototypes have been built and are currently being marketed and thermally monitored. The project received support from the U.S. DOE under its Passive Solar Manufactured Buildings Program. The goal of this project was to develop a prototype which incorporated passive solar technologies into modular housing. Because modular housing is an industrialized product, this incorporation involved relating to a construction process as well as deriving the design of a new product. This paper addresses the issues of modular housing production that impact energy efficiency, passive solar design, and architectural quality. The product's design evolution is described, with emphasis upon how solutions for the prototype(s) were derived in response to factory construction processes, cost, existing and potential markets and the extended goal to improve both energy efficiency and architectural design while introducing passive solar strategies.

48035 **Determination of residential energy conservation cost effectiveness.** Englund, J.S.; Cook, F.W.; Flechsig, A.J. (Dept. of Mech. Eng., Washington State Univ., Pullman, WA). *ASHRAE (American Society of Heating, Refrigeration and Air-Conditioning Engineers) Journal;* **25**: No. 11, 42-47(Nov 1983).

This article addresses five variables that indicate the measure of cost effectiveness for the five life cycle cost techniques discussed in terms of residential energy conservation. Values of each cost effectiveness variable under different study conditions are compared as indicated in the article in order to assess relative cost effectiveness. Conclusions drawn show that the effectiveness of weatherization increases as the cost of electric power rates increase, and that for the higher power rates partial weatherization is more cost effective than full weatherization though the full weatherization homes have a greater net present worth and greater net benefits at the higher power rates. The study finds that an investment in a large number of homes that are partially weatherized is better than a smaller number of homes that are fully weatherized because the rate of return is higher. Marginal cost effectivenesss is shown by all techniques at lower power rates, and may or may not be attractive to homeowners dependant upon the rate of return acceptable to the homeowner.

48036 **An economic analysis code for selecting building design options.** Flanagan, D.M.; Hamblin, D.M.; Thomas, B. (Energy Division, Oak Ridge National Laboratory, Oak Ridge, TN). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **89**: 3-28(Jun 1983). (CONF-830640—).

From ASHRAE conference; Washington, DC, USA (26 Jun 1983).

In the past, economic analysis of innovative building design options has not included considerations of the tax environments appropriate for different decision makers, the possible existence of innovative utility rate structures including such things as time-of-day rates, the possibilities for sale and resale of power, and multiple decision criteria for comparing alternative building investments. A Building Innovations Economic Analysis code (BIEA) is described, which satisfies these and other objectives as well. The code is designed in stand-alone form, to interface with a load simulation program or alternative building performance data development device of the user's choosing. To facilitate the interface, a user-friendly preprocessor for input data management and modification is described. The code is currently being employed in commercial sector work for the development of recommendations for ASHRAE standard revisions and in the residential sector for analysis of conservation and renewable energy options to new single-family house designs.

48037 **Correlations for convective heat transfer from room surfaces.** Altmayer, E.F.; Bauman, F.S.; Gadgil, A.J.; Kammerud, R.C. (Lawrence Berkeley Laboratory, Univ. of California, Berkeley, CA). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **89**: 61-77(Jun 1983). (CONF-830640—).

From ASHRAE conference; Washington, DC, USA (26 Jun 1983).

Correlations of the rate of heat transfer from room surfaces to the enclosed air, based on empirical and analytic examinations of convection in two-dimensional enclosures, have been developed. The heat-transfer data base from which the correlations were derived was generated by a validated numerical-analysis computer program. Simulations were performed for a variety of temperature and geometry boundary conditions. The correlations extracted from this data base express the heat-transfer rate in terms of boundary conditions relating to room geometry and surface temperatures. The correlations are applicable to a class of room configurations with cold and warm surfaces on opposite vertical walls. In this paper, the numerical-analysis technique is presented, the generalized methodology for developing simplified correlations is described, and correlation results are presented and compared to results using standard ASHRAE techniques. It is shown that the correlation significantly improves the accuracy of heat-transfer rate calculations in buildings.

48038 **Vertical concentric tube ground-coupled heat exchangers.** Mei, V.C.; Fischer, S.K. (Union Carbide Corp.). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **89**: 391-406(Jun 1983). (CONF-830640—).

From ASHRAE conference; Washington, DC, USA (26 Jun 1983).

An experimental and analytical project to study the design of vertical, concentric-tube ground-coupled heat exchangers for use in heat pump applications is described. The experimental apparatus consists of a concentric configuration of two 155-ft (47.2-m) polyvinylchloride (PVC) pipes (sealed at both ends with connections so that hot or cold water could be pumped through the system) with instrumentation to measure heat transfer. This heat exchanger was placed in a well with an 8-in (0.20-m) inside diameter (ID), which was backfilled with sand to establish good thermal contact. Heat transfer was measured for heat exchanger operation under several sets of operating conditions. A mathematical model was developed and converted into a computer program to simulate the operation of the ground-coupled heat exchanger. Data collected using the experimental apparatus was used to validate the computer program, and the computer model was then used to study the effects of variations in heat exchanger length, diameter, flow rate, and thermal conductivity and the thermal conductivity of the ground on the heat exchanger performance. Results are presented.

48039 **Design methods for ground-source heat pumps.** Ball, D.A.; Fischer, R.D.; Hodgett, D.L. (Battelle Columbus Laboratories, Columbus, OH). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **US**: 416-440(Jun 1983). (CONF-830640—).

From ASHRAE conference; Washington, DC, USA (26 Jun 1983).

A ground-coil heat pump system is defined as a heat pump in which the outdoor or evaporator coil is placed directly in the ground or exchanges heat with the ground through a secondary fluid (usually water or antifreeze solution), which is circulated through the ground in a closed loop. Ground-coil systems present a more challenging design problem than either air-source or well-water systems. For instance, the performance of the outdoor coil on an air-source system can be readily predicted once the outdoor air temperature and humidity are known. Well-water system performance can generally be determined at the time of drilling with established well-testing techniques. However, the performance of ground-coil systems is highly dependent on ground heat-transfer characteristics. Soil type (clay, silt, sand, etc.) and moisture content can cause ground thermal conductivities to vary by orders of magnitude from one part of the country to another, from one lot to another within the same town, or from one point in time to another for the same lot. Thus, there are many challenges and uncertainties in designing and installing ground-coil heat pumps. This project was undertaken with the objective of reviewing historical and current methods for designing ground-coil heat pumps. The efforts concentrated on European and North American experience. The following discussion presents the historical background followed by a description of basic design configurations, operating experience, and some specific design methods that have been developed or are under development.

48040 A high-efficiency heat pump fan. Wright, T.; Lackey, R.S.; Veyo, S.E. (Westinghouse Electric Corp., Pittsburgh, PA). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **89**: 755-769(Jun 1983). (CONF-830640—).

From ASHRAE conference; Washington, DC, USA (26 Jun 1983).

This paper documents efforts toward development of a high-efficiency outdoor air mover for an advanced electric heat pump. The design goal was to halve the outdoor air-moving electrical power. The prototype air mover at 850 rpm delivers 3070 scfm (1449 l/s) through the prototype outdoor unit with a pressure drop through the coil of 0.09 in (2.29 mm) of water and consumes 150 W of electrical power. The overall air-moving efficiency is estimated at about 35% compared with 19% for the conventionally applied heat pump fan. Although this air mover will cost twice as much as the conventional heat pump air mover, this premium cost should be recoverable in less than four years through energy savings. The sound rating (SRN) for this air mover is less than 20. Means have been identified for improving fan efficiency by 5 percentage points and motor efficiency by 2.5 points and to further quiet the fan.

48041 A high-efficiency indoor air mover. Ariewitz, D.; Lackey, R.S.; Veyo, S.E. (Westinghouse Electric Corp., Fluid Systems Laboratory, West Lafayette, IN). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **89**: 770-781(Jun 1983). (CONF-830640—).

From ASHRAE conference; Washington, DC, USA (26 Jun 1983).

A high-efficiency indoor air mover has been developed for the advanced electric heat pump. Preprototype air mover overall efficiency is approximately 46%, more than twice that of the conventionally applied squirrel-cage blower. The air mover consists of a 16.25 in (413 mm) diameter single-entry blower wheel carried in a volute sheet steel scroll and driven by a 1/3 hp (250 W) high-efficiency motor. The blower wheel uses ten backward curved, uniformly spaced, cambered plate blades. As installed in the advanced heat pump, the air mover consumes 390 W of electrical power and delivers 1405 scfm (663 L/s) at 1092 rpm into an estimated overall static-flow resistance of 1.09 in of water (271 Pa). Although this air mover will cost about twice as much as the conventional squirrel-cage blower and motor of comparable flow performance, the incremental premium cost at the retail level can be recovered in less than one year through energy savings with electricity at $0.05/kWh in Minneapolis, where the blower would run approximately 4900 hours per year.

48042 A detailed examination of the LBL infiltration model using the mobile infiltration test unit. Modera, M.P.; Levin, P.A.; Sherman, M.H. (Lawrence Berkeley Laboratory, Berkeley, CA). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **89**: 157-182(Jun 1983). (CONF-830640—).

From ASHRAE conference; Washington, DC, USA (26 Jun 1983).

The LBL infiltration model is a simplified method for combining weather information with air tightness to calculate residential air infiltration. In this report, the authors compare infiltration-model predictions with data collected by our Mobile Infiltration Test Unit (MITU), a full-scale test structure that gathers detailed weather and infiltration measurements. To probe for sources of prediction errors, the authors examine four simplifying assumptions made in the LBL infiltration model: 1) that the flow through the cracks in the building shell can be approximated by orifice flow, 2) that wind-induced and stack induced infiltration can be added in quadrature, 3) that wind-induced infiltration can be represented by averaging the values for three typical aspect ratios, and 4) that wind-induced infiltration can be represented by averaging the values for all wind directions. The authors use comparisons with measured data to examine these effects qualitatively, and use detailed computer simulations of infiltration in MITU to quantify each effect. The effects of each assumption are represented by the bias and scatter. (The bias is the average error, and the scatter is a measure of the ability of a model to track short-term fluctuations in infiltration rate.) The authors show that the orifice flow assumption causes an 8% bias and a scatter of 20%, and that the quadrature assumption causes consistent overprediction (bias = 12%, scatter = 6%). For MITU, averaging over aspect ratio causes some overprediction (bias = 11%, scatter = 14%). Although it reduces the ability of the model to track infiltration (scatter = 19%), averaging over wind direction has little effect on the mean infiltration rate (bias=0). When compared to measured data, the LBL model has a bias of 10% and scatter of 28%.

48043 A comparison of measured and predicted infiltration rates. Persily, A.K.; Linteris, G.T. (National Bureau of Standards, Washington, DC). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **89**: 183-200(Jun 1983). (CONF-830640—).

From ASHRAE conference; Washington, DC, USA (26 Jun 1983).

Tracer gas techniques can be used to measure air infiltration rates in buildings, but it is expensive and time-consuming to obtain a complete characterization of airtightness through these methods. Instead, there are models that predict air infiltration rates from pressurization test results and weather conditions. Other models predict air infiltration without the input of a pressurization test. In order to study the predictive accuracies of these models, a group of identical homes in Freehold, NJ was subjected to both pressurization and tracer gas measurements of infiltration. The infiltration and pressurization test results are compared. Four air infiltration models are used to predict the infiltration rates in the houses, and these predictions are compared with the measured rates. The predictions are made using several different values of the inputs required for the models, and the effects of varying these inputs are studied. Use of identical houses eliminates variability in the pressurizationinfiltration relation due to house style and vintage. Simultaneous measurements of infiltration in all the houses enables analysis of each night's data without the confounding effects of weather.

48044 Ground-coupled heat pump system experimental results. Metz, P.D. (Brookhaven National Laboratory, Upton, NY). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **89**: 407-415(Jun 1983). (CONF-830640—).

From ASHRAE conference; Washington, DC, USA (26 Jun 1983).

Since October 1980, a small house in Upton, Long Island, New York has been heated and cooled by a liquid-source heat pump using a shallow serpentine earth coil as a heat source/sink. This paper, introduces and describes the system, presents system performance data for the winter of 1981-82 and the summer of 1982, and discusses these results. The experimental test house is a 1120 ft^2 (104 m^2) three-bedroom ranch-style house of energy-saving construction with a heating load of 4.1 X 10^3 Btu/°F.day (7.8 X 10^6 J/°C.day). The heat pump used during most of the period reported on here is a commercially available water-to-air unit sized to just meet the building's design heating load with no auxiliary heat. The earth coil contains 507 ft (155 m) of nominal 1-1/2 in. (4 cm) medium-density polyethylene pipe and is buried 4 ft (1.2 m) deep. An antifreeze solution consisting of approximately 25% ethylene glycol in water is employed to permit subfreezing earth-coil operation. Two independent data acquisition systems, a datalogger-microcomputer system backed up by a Btu-meter, monitor the spaceconditioning system's performance. During the winter of 1981-82, the system, which extracted 14.7 X 10^6 Btu (15.5 X 10^9 J) of heat from the ground, operated with a seasonal performance factor (SPF) of 2.46. No resistance heating was used. The earth coil's minimum daily U-value observed during this season was 1.93 Btu/ft-hr-°F (3.34 W/m°C). During the summer of 1982, a total of 10.0 X 10^6 Btu (10.6 X 10^9 J) of heat was rejected to the ground. The system SPF was 1.91, with a minimum daily U-value of 2.04 Btu/ft-hr-°F (3.53 W/m°C).

48045 Ventilation efficiencies of wall-or-window-mounted residential air-to-air heat exchangers. Offermann, F.J.; Fisk, W.J.; Grimsrud, D.T.; Pedersen, B.; Revzan, K.L. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **89**: 507-532(Jun 1983). (CONF-830640—).

From ASHRAE conference; Washington, DC, USA (26 Jun 1983).

Mechanical ventilation systems with air-to-air heat exchangers can be installed into residences to provide energy-efficient supplementary ventilation for the purpose of controlling indoor concentrations of contaminants, odors, and moisture. Wall- or window-mounted units have become particularly attractive because they are relatively inexpensive and easy to install. However, because they lack an air-distribution system, concern has arisen over their ventilation performance. To address this concern, a series of experiments was conducted on two different models of wall- or window-mounted heat exchangers. The nominal ventilation efficiencies of these units have been determined by measurement of tracer-gas decay rates at several indoor locations to be in the range of 0.47 to 0.66. No significant correlations between nominal ventilation efficiency and heat exchanger model or operational strategies were observed. Significantly higher local ventilation efficiencies were noted in the rooms where the heat exchangers were operating. Some preliminary tests indicate that internal leakage between the airstreams contributes significantly to the ventilation inefficiency of these systems.

48046 Laboratory tests of a residential low-temperature water source heat pump. Mei, V.C. (Oak Ridge National Laboratory, Oak Ridge, TN). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **89**: 782-796(Jun 1983). (CONF-830640—).

From ASHRAE conference; Washington, DC, USA (26 Jun 1983).

A residential unitary low-temperature water-source heat pump was tested in the laboratory. Tests were performed over a broad range of source-water temperature 45 to 70°F (7.2 to 21.1°C) and water-flow rates 5 to 30 gpm (3.2 X 10^{-4}m^3/s to 8.2 X 10^{-4}m^3/s). The heat pump capacity and coefficient of performance (COP) were found to be linearly related to the source-water temperatures. In the heating mode, the capacity and COP increased with increasing source-water temperature and flow rate. In the cooling mode, the capacity and COP decreased with increasing source-water temperature but increased with increasing water-flow rate. However, when an assumed water-pumping power, for a 150 ft (46 m) total head, was taken into account in the COP calculation, it was found that the net COP for both heating and cooling decreased with increasing water-flow rate. For cyclic operation over the tested source-water temperature range, the coefficient of degradation, C /SUB D/, ranged from 0.196 to 0.137 for heating and from 0.131 to 0.161 for cooling. The effect of inlet air humidity was also studied for cooling mode operation. A sample calculation is included in the paper to demonstrate the application of the test results in calculating the annual performance factor (APF). The test results are used to form a data base on the performance of a typical residential, unitary low-temperature water-source heat pump.

48047 Ventilation efficiency: A guide to efficient ventilation. Skaret, E.; Mathisen, M.M. (Norwegian Institute of Technology, Division of Heating and Ventilating, Trondheim). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **89**: 480-495(Jun 1983). (CONF-830640—).

From ASHRAE conference; Washington, DC, USA (26 Jun 1983).

A two-zone mixing model is used to describe the concept(s) of and to define the effectiveness of ventilation. Multiroom aspects and procedures for measuring ventilation effectiveness are dealt with. The simple two zone model, experimentally verified by laboratory tests, predicts generally high effectiveness for ventilating systems using the displacement principle, taking advantage of stratification. Tests using this principle in an office room for one to three persons (28 m^2, 2.8 m ceiling height), are reviewed. Stratification was secured by supplying the ventilation air with a temperature always lower than the air temperature in the zone of occupation. Necessary heating of the room was provided for by using panel heaters under the windows; the air supply was located at the opposite wall. For winter conditions, the stratification was weak and also more or less impaired by the convective air circulation created by the panel heaters. However, the system behaved as a displacement flow type system. For summer conditions, effectiveness was usually higher than for winter conditions but was dependent on how the surplus heat entered the room. The lowest effectiveness occurred when the only heat sources were persons and solar-heated floors. The required supply-air temperature for cooling is higher when using the described principle instead of complete mixing. Ventilation effectiveness was higher for this ventilation design than complete mixing effectiveness in all tests.

48048 Outdoor testing of small scale naturally ventilated models. Chandra, S.; Kerestecioglu, A.; Ruberg, K. (Florida Solar Energy Center, Cape Canaveral, FL). *Building and Environment;* **18**: No. 1/2, 45-53(1983).

A new experimental technique for investigating the natural ventilation potential of new building designs is proposed. The method tests scale models of ventilated buildings outdoors in the natural wind. There is excellent agreement of results from this method with data from a similar full-scale building. Use of this method by building designers is discussed.

48049 Developing and monitoring a corporate energy management program. Graves, P.T. pp 173-179 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

This paper presents guidelines needed for a corporate energy Management Program to insure that a maximum reduction in energy costs is obtained and maintained while keeping the cost of a program to a minimum. A flow chart for Energy Management project implementation is given and detailed. The importance of the development of a strong base consisting of the energy management personnel, a building qualification program, funding, and an energy monitoring system is emphasized and the needs and requirements of each of these areas is discussed in this paper.

48050 Shared savings financing. Rauch, R.J. pp 227-228 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

This paper reviews the time-sharing plan of Time Energy Systems Inc., a publicly held corporation that markets energy conservation projects primarily through the shared savings concept. The advantages of shared savings include the lack of capital investment, immediately improved cash flow from reduced energy costs, transfer of technological risk to the energy service company, off-credit, off balance sheet financing, and significant competitive benefits. The paper also considers when a shared savings plan makes sense, and how to structure a shared savings plan.

48051 Economic evaluation of control systems under new tax provisions. Sheahan, P. pp 229-238 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

The decision to invest in a new control system is a two step process. First, the engineers must determine what the optimum configuration of the control system is, and what the stream of cost savings will be. Second the financial analysts weigh the discounted values of that stream against the initial cost of the system to see if the investment is a favorable use of corporate funds. Only after-tax calculations are useful in reaching the final buy/don't buy decision. New tax laws passed by Congress in 1981 and 1982 made important changes in the financial analysis that a prospective investment should receive. This paper shows (via a comprehensive example) how control system profitability is estimated, and how it is affected by the modern tax code.

48052 Building use and occupancy considerations as design parameters for reducing building operating costs. King, J.L. pp 259-260 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

This paper provides a model to be used as a tool for reaching design decisions which encompass the most beneficial features of energy technology as applied to design parameters concerning building use and occupancy. This model describes the interrelationship between the two current technological efforts, the limiting of operating costs, and the advancement of recovery, as well as their position relative to overall building design considerations. The evolution of design technology is described, and the design process is detailed. Several examples of the model in operation are given.

48053 Centralization: chilled water system. Gidwani, B.N. pp 269-271 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

This paper offers discussion, analysis, and a study of the cost savings of several areas which present potential energy and cost savings in chilled water systems, including, chilled water reset, condenser water reset, sequencing of the chillers, chilled water storage, and variable chilled water pumping. Because all of these areas can save considerable money it is important that the above items be evaluated in detail for both existing and new central chilled water plants.

48054 Utilizing EMS for productivity improvement. Williams, V.A. pp 279-282 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

This paper describes an Energy Management System set up in the Sunbelt which consists of a host Central Processing Unit, ten satellite Processing Units, sixty eight Field Multiplexing Panels, and approximately 4000 data points. The paper discusses in detail the start/stop control, control point adjustment by means of either automatic valves or automatic dampers, building the steam service valve CPA, status readout, flow readout, temperature readout, amperage readout, and various software features related to hardcopy printout chiller efficiency, and supply fan performance. This computerized energy system is intended to permit a great reduction in energy consumption, and to significantly increase the productivity of the maintenance and operating staff.

48055 Energy savings opportunities due to proper lighting control. Altstadt, G. pp 289-292 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

The goal of lighting energy management is to save energy or eliminate energy waste without decreasing the visual comfort while still meeting IES recommendations. This paper concentrates on five major areas where proper application of state-of-the-art lighting control systems can reduce energy expenditures while maintaining visual comfort. These include, overlight compensation (energy waste elimination), light loss factor compensation, daylight utilization, a combination of methods, and demand limiting.

48056 Additional savings opportunities for energy management systems users vis high-level user languages. Hoffman, T.W.; Lydon, W.P. pp 293-299 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

This paper examines the evolution of computerized energy management and building automation systems that led to the development of new energy savings tools, applications that invite their use, and specific programming examples. An example of an application-specific user language is given. RETURNS, the Process header, declarations, executable code, and other steps in the process are reviewed. Applications of the system are endless, though special circumstances require caution, as indicated.

48057 Utility monitoring and reporting systems: Key to successful energy management. Stebbins, W.L. pp 5-8 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

An essential building block in a well-constructed energy management program is a thoroughly thought out and engineered monitoring and reporting system. Energy cannot be managed and conserved unless there is a way to identify the major users and determine where the emphasis should be placed. Details presented include doing the impossiblejustifying energy system meters. Establishing realistic energy standards. Evaluation of vendor's claims. Samples of actual meters used. Using the "2M" Rule, if you can't meter it, you can't manage it.

48058 Case study: Actual energy cost/usage reductions. McGeachen, T. pp 283-286 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

The following paper deals with the estimated and actual energy cost/usage reductions of two very different buildings. These projects were completed at the Eastern Union County YMCA and can be applied to any dormitory type building for a 20% savings, and a commercial office building for a 78% savings in consumption.

48059 Potential for improved energy efficiency in existing homes in the Pacific northwest. Hirst, E.; Goeltz, R. pp 417-420 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

Analysis of results from home energy audits conducted in the Pacific Northwest show large potential reductions in electricity use. The average saving, across 359 audited all-electric single-family homes, is 7070 kWh/year, 34% of estimated preaudit consumption. Measures installed in these homes, as part of the Bonneville Power Administration's Residential Weatherization Pilot Program, cut consumption by an estimated 6200 kWh/year, at an average cost of $2100. Comparison of actual reductions in electricity use with audit predictions showed that the ratio of actual to predicted saving averaged 78%.

48060 Case study: Lockheed building 157 an innovative deep daylighting design for reducing energy consumption. Riegel, R.J.; Davy, K.V.; Shanus, M.D.; Windheim, L.S. pp 143-151 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

This paper features Lockheed Missiles & Space Company's Building 157, a 600,000 square foot energyefficient technical engineering office building in Sunnyvale, California. Discussion is directed towards the building's deep daylighting design solution for reducing energy consumption, the integration of daylighting with its photocell controlled lighting system, the design methodology, and annual energy performance. Daylighting features include sloped ceilings, interior and exterior light shelves, exterior shading devices, and a large skylight covered light space called a litetrium. A task/ambient fluorescent lighting system was selected to complement and integrate with the daylighting scheme. The indirect ambient system utilizes conventional lamps which are powered and controlled by solid-state high frequency dimming ballasts. Light levels are automatically controlled by photocells. A comprehensive daylight modelling effort involved 1/8"-scale and 3/8"-scale models, as well as a full-scale mock-up which was used to test electric lighting alternatives and to fine-tune design solutions. Daylighting model testing was accomplished for both clear sky and overcast sky conditions. Results indicate that more than 70% of the annual electrical energy required to maintain ambient lighting levels will be displaced by daylighting. Annual energy performance of the building was forecast with the DOE 2.1 computer program at level that is less than half that allowed by California's stringent Title 24 Energy Code.

48061 **Remote load control of large centrifugal chillers.** Cooper, D.S. pp 351-354 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

With the exponential demand for electric power, which has been experienced in the last few years, coupled with the difficulties of rapid conversion to alternative fuels, the electric utility companies find themselves in the rather precarious position of watching their demand curves approach their maximum generating capacity on an almost daily basis. Watching this situation develop with no direct way of combating it, has caused the power companies to consider the planned curtailment of power at certain times of day to prevent eventual brown-out or black-out, the impact of which is unthinkable. As a result of this, many companies confronted with the serious situations asked for help from the Federal Government and grants were eventually forthcoming for the purpose of developing ideas which could have the effect of reducing the demand, in a selective manner, and which would be fair and acceptable to the large users of power. The idea which the Houston Lighting & Power Company put forth was to provide some means whereby the large air conditioning systems could be remotely controlled by the central dispatcher to bring about power reductions as needed without affecting the other essential services in the buildings. It was considered that if something had to go, it should go quietly, without apparent impact upon the occupants or essential machines such as: elevators, computer systems, domestic water supply, etc. On account of his many years of experience with the control of large centrifugal compressors in air conditioning systems, the writer was commissioned to design and assemble a prototype "control box" which would systematically reduce electrical power input to all systems so equipped, using a discrete, frequency modulated (FM) radio signal actuated from the power dispatcher's office. This paper will explain how it was done and the effects obtained when applied to one of Houston's new high-rise office buildings.

48062 **The use of DOE 2.1 as an interactive design/analysis tool.** Riegel, R.J.; Shanus, M.D.; Windheim, L.S. pp 137-141 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

This paper describes a design tool--the DOE 2.1 computer program used by the architectural firm, Leo A. Daly--which adequately quantified climactic data and energy consumption levels so that the design team can make intelligent cost-effective decisions in designing an energy efficient building. The three phases of design are outlined: schematic design, design development, and final design. Four case studies are described in detail: a small branch bank in San Josa, CA, the Lockheed Office building 157 in Sunnyvale, CA, the El Cortez Hotel tower in Las Vegas, and the Reno main post office. Finally, cost and time concerns are summarized.

48063 **Prepackaged gas cogeneration systems for hospitals.** Clements, J.R. pp 201-203 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

In September 1982, United Enertec Inc., and Martin Cogeneration systems were contracted by GRI for Phase I of the R & D of a Packaged Cogeneration system for hospitals. Phase I accomplished application analysis, module design and performance analysis, component selection, and commercial feasibility assessment. Phase II will study some of the key variables of the project, including first cost of hardware, installation cost, maintenance, reliability, system efficiency, and actual savings.

48064 **Engineering considerations for wood fired systems.** Spelman, P.T. pp 213-217 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

This paper studies a number of specific benefits that can be anticipated when biomass fuel energy systems are implemented: fuel is locally produced, fuel money acts as a stimulant to local economy, the forest resource is enhanced, fuel harvesting provides a laboratory, the facility saves money, acid rain is reduced, landfill requirements are reduced, and residue or ash is an agricultural fertilizer. Wood burning systems such as gasification or pyrolysis, direct burning, and fluidized beds are reviewed. Finally, case studies of the Central Michigan University system, and a high school system are given.

48065 **Influence of proportional control dynamics on energy consumption in environmental control systems.** Mehta, D.P.; Kharsa, J.E. pp 241-249 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

The development of common sense energy saving strategies for the operation and maintenance of building systems seems to be nearing completion. Further energy savings in buildings will have to come through strategies which are based upon better design and optimal control of building systems. The control system dynamics have a strong influence on the energy consumption patterns of a building environmental control system and the study of control system dynamics can lead to the derivation of energy saving strategies. The purpose of the research reported in this paper was to study the effects of the building system control dynamics on energy consumption and on the occupant's thermal acceptability in an occupied space with proportional control. A modified rational model was applied to derive relationships between the throttling range, proportional band, reset time, coil capacity and part load operation. The effects of these relationships on the energy consumption in a fan coil system for a classroom and on thermal acceptability by the occupants have been studied and reported in this paper. These studies have been used to derive some new control strategies for reducing energy consumption in building environmental control systems with proportional control.

48066 **Cooling systems cost avoidance.** Armwood, L.G. (Dexter Corp.). pp 251-253 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

This paper discusses the factors which can be controlled to reduce head pressures and minimize compression electrical costs in the operation of vapor compression chiller systems. The paper addresses three of the most common causes of high head pressures in such systems: high cooling water temperature, air in the refrigerant, and fouled condenser tubes. Case studies of a high school chiller system, A Cooling CARE analysis of a hospital system are given.

48067 **Total energy conservation in a municipal building.** Teji, D.S. pp 261-267 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

In the Fiscal Year 1977-78 the City of Phoenix City Hall Building consumed close to 7 million kilowatt hours of electric energy with 1469 KW maximum demand. The 12 story building houses general offices, Management Information System, Word Processing and a cafeteria. Major energy consuming load consists of lighting, heating ventilating and air conditioning besides computer equipment. The building HVAC system has a dual duct, hot and cold system, using constant air volume with variable temperature for cooling and heating the building. Four supply air fans and two return air fans with a total of 340 horsepower installed capacity provided air handling for the top 10 floors. Refrigeration cooling is provided by two 400 ton centrifugal chillers. All the lights are fluorescent 48" lamps. This paper contains description of all the low cost and capital cost energy conservation measures implemented to bring the electric energy consumption down to 4 million kilowatt hours and 704 KW demand. These projects consist of lighting reduction and control measures, converting the building to variable air volume system, evaporative precoolers, low leakage dampers, adjustable speed drives (Inverters) for supply fans and chiller pumps and various other low cost and capital cost measures. This paper also discusses description of energy audit conducted on the building, energy analysis and the energy conservation measures identified as a result of energy audit. Future projects planned for further energy conservation are also discussed. This paper sets up an example of how similar buildings can be energy audited and maximum energy savings accomplished. The paper presents tabulation of energy conservation data before and after the implementation of energy conservation measures.

48068 **Status of federal energy funding.** Stewart, F.M. pp 309-310 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

This paper briefly reviews the status of federal energy funding and cites examples in various states where the funding occurs. Montana programs including the DOE's Schools and Hospitals program, its program to provide grants and loans to fund renewable technologies, and a program in the Great Falls School District are reviewed. Other innovative plans in California and Nebraska are also studied.

48069 **How to use generic building concepts to streamline energy audits.** Hodge, B.K.; Steele, W.G.; Walker, R.D. (Mississippi State Univ.). pp 403-408 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

A simplified method is presented for conducting energy surveys of buildings in the same generic class. Special emphasis is placed on determining the actual end-point energy usages for the buildings and on comparing these with target values that have been determined for buildings that are run energy efficiently. The factor used to categorize the energy consumption is the Energy Utilization Index, and target values are given for school, local government and small commercial buildings. Examples are given to demonstrate the procedure.

48070 **Energy management tracking system tracking energy improvements in municipal buildings.** Norton, R. pp 463-469 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

Applied research conducted at the City of San Jose has enabled the development of the Energy Management Tracking System (EMTS). The purpose of the computer-based system is to support management in evaluating the effectiveness of building energy efficiency improvements to buildings. Obtaining documentation which proves the record of energy conservation is the primary objective. Project direction by the City's Energy Office has resulted in both linking existing files and creating new computer files which, in turn, are used to produce summary reports. The resulting reports furnish energy consumption comparisons before and after the occurrence of an energy improvement to a building. In the near future, as the historical record for energy improvements lengthens, the Energy Office will be able to accurately assess cost effectiveness and verify payback for any combination of 35 types of building retrofit energy improvements. The output ranks buildings in terms of energy use intensity which assists in selecting candidates for future retrofits. In a different mode, the system permits analysis of energy conservation behavior practices by building occupants when no retrofit has occurred. The paper includes an example of the methodology applied to a retrofitted municipal warehouse.

48071 **Slashing steam use at Carnegie Mellon University.** Wisch, A.J.; Porter, P. pp 481-485 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

This paper describes the saving of steam at Carnegie-Mellon University through the use of a comprehensive computerized steam metering system. Improvements in use have saved the University almost one half million dollars alone in steam use reductions. The means by which this reduction in particular was acheived--through steam metering, steam sleuthing, the CMU EMS system, vigilance, maintenance, and trade-offs-is the focus of this paper.

48072 **Upgrading thermal performance through building insulation.** Dunlop, R.B.; DeLape, F. pp 161-164 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

This paper discusses recent technological advancements made by the fiberglass insulation manufacturing community in their insulative materials and proper fire-rate insulation facings. Newly developed fastening systems that make insulation cost effective from an economic analysis and how insulation can play a vital role in controlling noise pollution, increasing light reflectivity, worker productivity, and enhancing the aesthetic look of a facility are also studied. Case studies of roof insulation, window area insulation, side wall application, and the participation of the American Insulators in the insulation of the hangar for Air Force One are described in detail.

48073 **Energy conservation through advanced boiler water treatment.** Cappabianca, C.J. pp 165-171 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

This paper explores the energy conservation potential of advanced boiler water treatment. First, energy loss estimations due to deposits and corrosion are presented. Next, traditional treatment methods such as natural organics, carbonate cycle, alkaline phosphate treatment, corrosion inhibitors such as sodium sulfite, neutralizing amines, and octadecylamine are reviewed through an historical approach and their individual drawbacks noted. Finally, the effects and benefits of advanced boiler water treatment programs using deposit inhibitors, chelant-based treatments, polymer-based treatments, and the corrosion inhibitor hydrazine are explored.

48074 **Absorption chiller heater applications for commercial buildings.** Milne, D.S.; Fallek, M. pp 195-199 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

This paper discusses the flexibility that absorption chiller heaters offer; the advantages they provide compared to mechanical refrigeration; why the chiller heater efficiency is so high compared to the old standard absorption air conditioners; a new way of using absorption units with a heat reclaim cycle; and finally offers case studies of installations in the past five years.

48075 **Technology advances in gas space conditioning.** Hemphill, R.J.; Johnson, O.D. pp 205-209 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

The Gas Research Institute's efforts in the residential/commercial space conditioning area focuses on development of space conditioning technologies that will bridge the gaps in price and performance between existing gas furnaces/boilers and advanced technology equipment including gas-fired heat pumps now under development. Pulse combustion, desiccants, heat pipe heat exchangers, and fiber matrix burners are detailed and schematicized in this paper.

48076 **Energy management in a decentralized, non-energy-intensive manufacturing firm.** Priestley, D.W. pp 327-329 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

How does the Corporate Energy Manager accomplish his goal of improving energy efficiency in a decentralized company? He must have the support of the company executives, he must establish a positive working relationship and reputation for being helpful with division presidents, he must sell himself to the plant engineers and maintenance managers, and he should minimize the demands on the division engineer's time. An effective energy program at McGraw Edison follows these steps: develop operating management support, aduit energy usage, analyze costs and savings of potential projects, implement projects, and measure and report energy usage, all of which are detailed for different size plants.

48077 **Energy conservation implementation rates in the commercial industrial sector.** Flynn, J.F. pp 355-356 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

This paper evaluates the implementation of energy conservation recommendations made in 1983 by commercial/industrial energy auditors employed by San Diego Gas & Electric. This paper presents an analysis of data collected during six years of audits as it reflects conservation decisions made by SDG & E's audited customers in 1983.

48078 **Motivating industrial employees to actively conserve energy.** Eibes, T.J. pp 367-374 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

The purpose of this presentation is to develop a model that describes the elements needed to motivate industrial employees into an active awareness of energy conservation. The fundamentals of behavior, need and motivations, are studied in detail. A model to motivate employees must include meaningfulness, responsibility, and performance feedback, all of which are studied. The behavior elements that underlie the model presented are those of Herzberg, McClelland, and Hackman and Oldham.

48079 **Automating industrial and commercial audits.** Kolodkin, S.S. pp 397-402 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

This paper presents XENCAP /SUP tm/ a system of computer programs and a data collection system including input forms, a quality control module, a report generation package, a building and end use database, and a management reporting system to control and monitor the process and documentation, which allows an energy auditor to prepare a complete energy audit report in less than four hours. The audit process using XENCAP /SUP tm/, including pre-audit, audit data collection, data entry, the audit program, and the data, is described in detail, and schematicized.

48080 **Industrial energy management programs today.** Mozzo, M.A. pp 423-424 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

The time period of 1982-1983 has seen still another scenario in the energy picture. Industry is in a state of recession causing many to reduce staff and operating expenses. Oil prices have dropped drastically, and oil and natural gas supplies are abundant. The temptation exists to eliminate a corporation's energy management program. In order to continue such a program, strategies must be revised to maintain success. This paper discusses three key issues. First, is there still an energy crisis? Second, how can one make the best use of limited capital funding in an energy management program? Third, how energy costs can be contained through utility rate case intervention.

48081 **Measurement of energy productivity in industrial processes.** Hatcher, N. pp 425-428 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

This paper describes methods for measuring energy productivity in a typical industrial process situation. The paper describes the use of thermal standards, production equivalents and simplified energy productivity reporting in a process industry. Historical data is produced, current budget determined, setting and revising of standards, the use of production equivalence, measuring the trends, and the impact of production level are all taken into consideration in the process.

48082 **Advances in energy cost savings for industry and buildings.** Atlanta, GA, USA; Fairmont Press (1983). 439-441p. (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

This paper describes the energy mix at General Motors, estimates GM's energy costs by form, indicates where all the energy is used, shows the effective price of fuels used by GM, documents a shift toward the use of coal in recent years, and projects the escalation of energy use in GM's plants due to robot use and the development of automotive paints.

48083 **Closed loop water source heat pumps--a viable alternative for a northern climate.** Luke, R.S. pp 79-85 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

This paper discusses the use of the closed loop water source heat pumps to reduce heating/cooling costs in commercial or office buildings. The principal components of the system is a series of small self-contained heat pump units which have the capability of reversing the flow of hot and cold refrigerant gas, and can be placed anywhere in buildings. Air conditioner cooling, cold weather operation, hot weather operation, and moderate weather operation are schematicized. Heat pump design specifications are given, and monthly consumption charts and budget estimating charts from two case histories of heat pump use are presented.

48084 **A current energy assessment for the industrial user.** Santangelo, F.J. pp 27-30 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

How does a company get and maintain a committment to energy conservation when there are no headlines today relating energy shortages and crises? Johnson & Johnson organized the Energy Steering Committee consisting of all vice-presidents of operations. The Steering committee, administers the following functions: develop and implement corporate energy strategy, assure continuity of operations, develop and maintain an energy profile for each facility, analyze energy supply and costs, oversee energy conservation programs, measure energy use and conservation, keep abreast of new technologies, and establish worldwide energy steering committees. The work of the Technical Advisory Council, the backbone of energy technology expertise within the company, is also described in detail.

48085 **(OA-tr—2554) Operation and supply aspects of bivalent heat pumps.** Broschk, J.; Hotopp, R. Aug 1982. Translation source information not available . 32p. NTIS (US Sales Only), PC A03/MF A01. File Number DE84901840.

The evaluation of measurements of 41 bivalent air/water heat pumps for space heating and partly also for hot water preparation in detached and semi-detached houses permits the following statements to be made with respect to the average operation: there is hardly any difference between plants with and without hwp. The heat pumps show about 2340 operating hours per year. Maximum monthly connect-times occur in March and November and reach 300 h/month and a daily maximum of 15 h/day. The electricity consumption over the year was about 8585 kWh on average for a heat pump installation. The results with respect to supply aspects can be summarized as follows: for a group of up to 27 bivalent heat pumps the most unfavourable number of starts is 3 per hour and installation; hwp has no influence. Only for smaller groups of up to 3 installations, a higher number of starts is to be expected.

48086 **International residential energy end use data: analysis of historical and present day structure and dynamics.** Schipper, L.; Ketoff, A. (Policy Analysis Group, Lawrence Berkeley Laboratory, Berkeley, California). pp 969-981 of Building energy management-conventional and solar approaches. De Oliveira, F.E. Oxford, England; Pergamon Press (1981). (CONF-800524—).

From International congress on building energy management; Povoa de Varzim, Portugal (12 May 1980).

International comparisons of residential energy use have been hindered in the past by lack of data and common measuring systems. In this paper the authors report on ongoing efforts to disaggregate data on residential space comfort and appliance energy use for major OECD countries. Indicators of structure (i.e. dwelling size, number of appliances, incomes) and of intensity (energy use per degree day, etc.) are developed for various countries and compared. It is shown that in certain OECD countries there is much room for energy conservation by reductions in energy intensity even as structural factors -- rising incomes -- increase energy use.

48087 **Indoor air quality in residential buildings.** Hollowell, C.D.; Berk, J.V. (Lawrence Berkeley Laboratory, University of California). pp 727-735 of Building energy management-conventional and solar approaches. De Oliveira, F.E. Oxford, England; Pergamon Press (1981). (CONF-800524—).

From International congress on building energy management; Povoa de Varzim, Portugal (12 May 1980).

Rising energy prices, among other factors, have generated an incentive to reduce ventilation rates and thereby reduce the cost of heating and cooling buildings. Reduced infiltration and ventilation in buildings may significantly increase exposure to indoor contaminants and perhaps have adverse effects on occupant health and comfort. Four indoor air contaminants -- carbon monoxide and nitrogen dioxide from gas appliances; formaldehyde from particleboard, plywood, urea-formaldehyde foam insulation, and gas appliances; and radon from building materials, soil, and ground water -- are currently receiving considerable attention in the context of potential health risks associated with reduced infiltration and ventilation rates. The authors have measured and analyzed these air contaminants in conventional and energy efficient buildings with a view to assessing their potential health risks and various control strategies capable of lowering pollutant concentrations. Preliminary findings suggest that further intensive studies are needed in order to develop criteria for maintaining acceptable indoor air quality without compromising energy efficiency.

48088 **Energy audits of existing residential buildings insitu with a microprocessor.** Sonderegger, R.C.; Grimsrud, D.T. (Energy Performance of Building Group, Energy and Environment Division, Lawrence Berkeley Laboratory). pp 897-909 of Building energy management-conventional and solar approaches. De Oliveira, F.E. Oxford, England; Pergamon Press (1981). (CONF-800524—).

From International congress on building energy management; Povoa de Varzim, Portugal (12 May 1980).

In this paper the authors describe an energy audit procedure developed for determining economically optimal retrofits for a residential building. This audit is a microprocessor-based, interactive, site and house specific package addressing conservation, solar, and wind measures. A dynamic model of heating and cooling loads with algorithms to calculate internal heat and solar gains is used to evaluate fuel savings. Special attention is given to the estimation of monthly average air infiltration rates, using a model correlating pressurization results with air infiltration under natural weather conditions. Load calculations are checked against existing utility records of fuel use. Retrofits optimized for maximum net life-cycle savings can be further adjusted on site in accordance with the homeowner's preference.

3202 Transportation

REFER ALSO TO CITATION(S) 32020048132

48089 **(DOE/CS/69105—1) School Transportation Energy Program (S.T.E.P.). S.T.E.P. curriculum guide.** Jun 1984. Contract FG02-80CS69105. 88p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE84017577.

The S.T.E.P. Curriculum Guide is made up of 5 lessons. These may be taught in individual sessions applicable to a specific school transportation operation, or they might be taught in a block fashion. The lessons are: Fuel Economy in School Transportation - Why it is Essential; Fuel Conservation is a Science; Fuel Efficient Driving Techniques; Fuel Efficiency Through Proper Maintenance; and Administrative Considerations for Fuel Efficiency. It is recommended that the film, Who Cares, be used at the conclusion of Lesson 4. This film summarizes the concepts and ideas set forth in the preceding lessons.

48090 **(DOT-I—82-24) Transportation energy contingency plans for rural areas and small communities.** Dare, C.E. (Missouri Univ., Rolla (USA)). Dec 1981. 146p. NTIS, PC A07/MF A01. File Number DE84901217.

This study was undertaken to determine the most effective transportation fuel conservation measures which could be implemented by such areas during energy emergencies. The study involved a review of the transportation fuels contingency planning literature, state transportation energy contingency plans (with special emphasis on that for Missouri) and transportation studies recently conducted in rural Missouri, together with a survey by mail of local government officials, telephone interviews with rural residents and participation in two community-wide attitude surveys in the Meramec Region of Missouri. On the basis of the review of the literature and the results of the surveys, recommendations have been made on both the strategies that could be implemented to reduce gasoline consumption in rural areas and the institutional arrangements required for coping with a transportation fuels shortage. For small communities and rural areas of Missouri, it was specifically recommended that the multi-county regional planning commission should become the lead agency in implementing and coordinating fuel conservation measures in the event of a serious petroleum shortfall. Each regional planning commission would serve as a single focal point in communicating with the State Energy Office in behalf of its numerous county and city members. Furthermore, the existing statewide network of emergency preparedness officers should be utilized to inventory local fuel distribution services, monitor local service station operating practices and to serve motorists who might be stranded without fuel. Finally, the University of Missouri Cooperative Extension Service should offer educational programs covering topics as fuel conserving driving techniques, vehicle maintenance, trip planning, and ridesharing.

3203 Industry And Agriculture

REFER ALSO TO CITATION(S) 32030047437, 47438, 47738, 48038, 48132, 48249, 48297

48091 (CONF-840905—2) Technical feasibility and economics of retrofitting an existing nuclear power plant to cogeneration operation for hot water district heating. Kolb, J.O. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85000931.

From Joint power generation conference; Toronto, Canada (30 Sep 1984).

This paper presents the results of a study of the hypothetical conversion of two 560-MW(t) PWR plant turbines to cogeneration operation to supply a future hot water district heating system load in the Twin Cities of Minneapolis-St. Paul. The conceptual design of the nuclear turbine retrofitted for cogeneration and of a hot water transmission system has been performed, and the capital investment and annual owning and operating costs have been estimated for thermal energy capacities of 600 and 1200 MW(t). Unit cost of thermal energy for cogenerated hot water at the nuclear plant gate has been estimated to be competitive with the cost from a coal-fired cogeneration plant. The unit cost of delivered thermal energy was based on a 36-mile-long (57.9-km) transmission route between the Twin Cities and the Prairie Island Nuclear Plant. Major variables considered in this study include: (1) inclusion of back-pressure turbines in the retrofitted nuclear steam system to maximize cycle efficiency; (2) transmission system delivery capacities of 600 MW(t) and 1200 MW(t) corresponding with a retrofit of one or two nuclear turbines; (3) reduced transmission distances from the 36-mile system design basis; (4) the effect of fixed charge rates on the capital investment costs ranging from 15 to 21% per year; and (5) effect of firm vs oil-interruptible service modes on the annual unit cost of delivered thermal energy.

48092 (DOE/ID/12379—T1) Membrane research in energy and solvent recovery from industrial effluent streams. A report for the period 5 November 1982-5 November 1983. Baker, R.W. 1983. Contract AC07-83ID12379. 59p. NTIS, PC A04/MF A01; GPO Dep. File Number DE84016819.

Several polymers have been found which have high fluxes and the required selectivity to separate organic vapors from air. A composite membrane coating machine has been made and the best polymer materials have been formed into high performance membranes. The technology required to form these membranes into low-cost spiral wound membrane modules has been developed, and the first of these modules have been constructed and are now being evaluated.

48093 (EPRI-EM—3656) Heat pumps in distillation processes. Final report. Harris, G.E. (Radian Corp., Austin, TX (USA)). Aug 1984. 243p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920022.

The methodology and results of an investigation of the range of economical applicability for electric-driven heat pump retrofits to existing distillation columns are reported. The core of the study was the development of a computerized design and economics evaluation program for heat pump retrofits. This consisted of two independent programs - the PROCESS simulation package for conceptual design and the COST program for cost estimation and life-cycle economic analysis. The evaluation programs were applied to five candidate distillation processes and the sensitivities of major design and economic factors were evaluated. A survey of heat pump manufacturers, case histories of existing units, a review of novel applications, an investigation of emission offset potentials, and a distillation heat pump bibliography are also included. The report appendices contain a users' manual for the COST program and example input and output formats for both programs.

48094 (NP—4901799) Corn production methods to achieve energy conservation in drying Ohio's corn crop. Final report, March 1, 1978-March 31, 1981. Keener, H.M. Apr 1981. 22p. Department of Development, P.O. Box 1001, Columbus, OH 43216. File Number TI84901799.

The main approaches of this project have emphasized management practices which lead to drier corn at harvest without reducing yields and the selection and management of more energy-efficient drying systems. Growing practices that have been promoted included earlier planting and hybrid selection for early maturity and fast drydown. Drying practices which were emphasized included higher air temperatures and in-bin cooling of grain by farmers currently using high temperature dryers; and shallower depths using natural (unheated) air for in-bin drying systems. Approaches used in the project to present information have been written materials in the form of bulletins, leaflets, news releases, and magazine articles; workshops and schools on energy conservation in corn production; and TV and radio presentations.

48095 (NYSERDA—84-14) Assessment of industrial heat pumps. Final report. (Little (Arthur D.), Inc., Cambridge, MA (USA)). May 1984. 101p. NYSERDA, Two Rockefeller Plaza, Albany, NY 12223. File Number TI84901481.

This report describes current and developmental industrial heat pump technology options. The information contained in this document was obtained from industrial developers of heat pump systems, discussions with program managers of the Department of Energy, Gas Research Institute, and Electric Power Research Institute and reviewing pertinent reports and product literature. The information is presented as follows: review of commercially available industrial heat pump technologies, new industrial heat pump system and component technologies, foreign industrial heat pump activities, issues affecting the development of new technologies, the economics of industrial heat pump utilization, legal and institutional issues, and evaluation of new technologies. 23 references, 17 figures, 9 tables.

48096 (ORAU/IEA—84-9(M)) Electricity and the geographical deconcentration of manufacturing. Barkenbus, J.N. (Oak Ridge Associated Universities, Inc., TN (USA)). Sep 1984. Contract AC05-76OR00033. 55p. NTIS, PC A04/MF A01; GPO Dep. File Number DE84017162.

Geographical deconcentration of manufacturing is occurring in this country in parallel with the dispersion of the general population. Access to relatively inexpensive energy, regardless of the location, has made deconcentration possible. Though the mobility of energy, and particularly electricity, is largely taken for granted today, its significance in permitting regionalization and decentralization should not be overlooked. The construction of a truly national energy system has taken place as manufacturers have gradually been moving away from the classical American manufacturing belt. Data are marshaled to document the movement of manufacturers away from the urban core of metropolitan areas and, a more recent trend, the movement from the larger metropolitan area itself and into the countryside. Based upon limited data, there appears to be a positive association between greater nonmetropolitan manufacturing employment and increasing electricity use. The deconcentration momentum has not stalled in the face of the energy shocks witnessed during the 1970s. Electrification and manufacturing deconcentration are likely to advance together in the future.

48097 (PB—84-175942) Energy conservation in mining operations. Open file report 7 July 1981-30 November 1982. Stanek, E.K.; Suryanarayana, N.V. (Michigan Technological Univ., Houghton (USA)). Dec 1982. 118p. NTIS, PC A06/MF A01.

This study, performed on a case study basis, can be divided into two parallel thrusts: electrical and thermal energy conservation. Energy consumed annually in mining and refining operations represents about 6% of the 80 quadrillion Btu's consumed nationally. In the electrical portion of the study, five areas were addressed: optimal dispatching of on-site generation, high-efficiency motors, conductor selection, power factor correction, and high-efficacy lighting. In the case study mine, which has a multiple unit on-site generation system, optimally dispatching units can save significant energy. The other four methods are difficult to justify on a retrofit basis due to capital costs. In the thermal portion of the study, a thermodynamic analysis was performed on the reverberatory smelting process. Possible areas of energy conservation were identified as radiation and convection heat losses from the furnace arch and the dumping of high energy content smelting slag.

48098 **(PB—84-193341) Heat diagnoses made on tunnel kilns and on belt drier: basic information.** Novay, M. (United Nations Industrial Development Organization, Vienna (Austria)). 30 Jan 1984. 46p. NTIS, PC E04/MF E01.

A report is made on diagnostic measurements of heat consuming units in the ceramics industry from the point of view of their operation, adjustment and energy saving. It covers technical parameters, objective of measurement, diagnostic method and applied apparatuses, testing results and their evaluation for (1) tunnel kiln for firing wall tiles (2) belt drier for washed kaolin.

48099 **(PB—84-199298) Electrolytic method for recovery of lead from scrap batteries: scale-up study using 20-liter multielectrode cell. Report of investigations/1984.** Lee, A.Y.; Cole, E.R. Jr.; Paulson, D.L. 1984. 27p. (BM-RI—8857). NTIS, PC A03/MF A01.

Library of Congress catalog card No. 83-600347. See also PB82-141045.

Anodes cast from scrap battery lead were electrorefined in a 20-L multielectrode cell for 3 to 7 days. The anodes, containing 2 to 2.5 pct antimony, were ideal for obtaining firm and adherent slime blankets. Cathode deposits, assaying 99.99 pct Pb, were obtained, with current efficiencies near 99 pct. Sludge leaching was done in 100-L tanks followed by filtering in 61 cm square vacuum pan filters. Lead of greater than 99.99-pct purity was recovered from the filtrate by electrowinning in a 20-L multielectrode cell using insoluble PbO2-Ti (lead dioxide-coated titanium) anodes and pure lead cathodes. The fluosilicic acid electrolyte depleted in lead was repeatedly recycled to leach more sludge, and there was no problem with impurity buildup.

48100 **(PB—84-203389) Potential for heat recovery from beef rendering operations.** Goulston, C.L. Oct 1983. 12p. NTIS, PC A02/MF A01.

The report describes an actual application of the addition of a heat recovery system to an existing beef rendering system. Included are the savings calculations and ownership and operating costs.

48101 **(PB—84-206671) Industrial applications of high temperature gas engine driven heat pumps.** Eustace, V.A.; Smith, S.J. (Commission of the European Communities, Luxembourg). [1984]. 53p. (EUR—8860-EN). NTIS, PC E04/MF E04.

Condensed and full length reports present work undertaken during Phase III of the high temperature heat pump project covering industrial applications of the unit. Four potential applications of the heat pump which have been identified are in the chemical industry; a distillery; a maize cooking process, and in a dyehouse. These are examined in some detail. An experimental programme has been carried out using the IRD heat pump to obtain data on the off-design and part load running conditions. Operation and performance of the system proved satisfactory throughout the test programme. No decomposition of the compressor oil or refrigerant had been observed during the test period.

48102 **(PB—84-207091) Study of availability and composition of metal bearing wastes (generated in titanium extraction and fabrication, aluminum smelters, chromite bearing refractory and foundry sands and mercury battery industries). Open file report 30 September 1983-10 April 1984.** Krishnaswamy, R. 13 Apr 1984. 128p. NTIS, PC A07/MF A01.

Waste streams generated by mineral, metallurgical, and consumer industries carry in them recoverable metals or minerals of economic or strategic importance. This report summarizes the results of a study identifying the major waste streams, evaluating current practices of waste treatment, and their development requirements. Priorities are identified for the developmental work by assigning weightage factors from economic, strategic, and environmental importance as well as on the lead time that may be required for process development. The study covers the following industries and wastes in the United States: titanium extraction and fabrication, aluminum smelters, chromite-bearing refractory and foundry sand wastes, and spent and scrapped mercury batteries.

48103 **(PB—84-207844) High-temperature ceramic recuperator and combustion air burner programs. Semi-annual report May-October 1982.** Coombs, M.; Kotchick, D.; Strumpf, H. Oct 1982. 203p. NTIS, PC A10/MF A01.

See also PB83-244046.

This document is the semiannual report on the high-temperature ceramic recuperator program and its companion program, the high-temperature preheated combustion air burner system. Since these two programs represent the two major components of an integrated system, this report summarizes the work performed on both programs. The two programs were initiated in April 1981 and will be completed by the end of 1984. A previous report summarizes the first year effort; this report summarizes the results obtained from May 1982 through October 1982. AiResearch is prime contractor to GRI on both the ceramic recuperator and the high-temperature burner program. However, AiResearch has subcontracted the high-temperature burner development to the North American Manufacturing Company of Cleveland, Ohio. The objectives of these programs are to design, develop, fabricate, field-test, and establish the commercial feasibility of an advanced, high-temperature ceramic recuperator and a high-temperature combustion air burner for application in an air preheat energy recovery system. The system will employ gas-to-gas ceramic recuperators that can operate in typical industrial flue gas streams in the 1900 to 2500F range. The burner will be capable of operating with combustion air preheat temperatures of up to 2000F with either natural gas or Number 2 fuel oil. Such a system offers the potential for fuel savings in excess of 50 percent.

48104 **(PB—84-207869) High temperature metallic recuperator. Final report January 1980-December 1983.** Ward, M.E.; Smeltzer, C.E. Nov 1983. 179p. (SR—83-R-4861-45). NTIS, PC A09/MF A01.

See also PB83-243956.

This final report presents the successful operation in an actual production facility since December 1982 of a high temperature waste heat recovery system preheating combustion air to above 1500F. It is considered the major milestone of this project. Probably more significant than the actual preheat levels is operator and facility management complete satisfaction with the new high technology recuperated box-type forge furnace and their enthusiastic support during the field test of this new equipment. Their enthusiasm results from no significant problems from the system, reliable operation, demonstrated fuel savings in the neighborhood of 42%, the significant increase in product quality and decrease in furnace heat times (increase in furnace productivity). This has led company management to the acquisition of four additional recuperators for their 1984 facility improvement program.

48105 **The industrial sector technology use model.** Lane, H.L. pp 313-320 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

A credible tool for analyzing and understanding the impacts of public policy and business decisions on industrial energy use has been developed. The analytical model, a computer program called the Industrial Sector Technology Use Model (ISTUM) is expected to be broadly useful to public policy analysis. ISTUM analytical framework, model capabilities, test results, and energy efficiency trends in each of four major industries, as determined by ISTUM, are given.

48106 **New tools for energy managers: demonstrating the cost effectiveness of conservation investments.** Reid, M. pp 359-366 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

It is claimed in this paper that because the results of a major report of conservation investment in industry were based on case studies of energy managers, and that energy managers are frequently not equipped with the analytic tools to satisfy the objectives, the results of the economic analysis of proposed projects is often overly simplistic and incorrect. This paper therefore presents some new ways of looking at potential energy conservation investments, and explores common pitfalls in economic analysis of conservation projects.

48107 **Problems caused by electrical energy improvements.** Schmidt, D.M. pp 409-415 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

It's important to save energy, but the Energy Manager must be careful to not create problems along the way. Pitfalls in reducing electrical energy costs seem to be found in these main areas: power-factor correction, lighting, controls, and generation. There are numerous details that must be considered when attempting to improve power factor. Among the most important are: unbalance caused by capacitor fuse blowing, unwanted resonant conditions, presence of harmonics, leading power factor, reduced reliability, reduced safety, and paybacks that never materialize. Controls designed to regulate energy may, nonetheless, cause some problems of their own. These are: control malfunction; increased requirements for training, troubleshooting, operation and repair; increased safety hazards; reduced flexibility; increased cost of making changes; and outages, down time and loss of production. Use of local power systems (in-plant generation) has solved many problems, but created a few, too. Watch out for: reduced reliability; increased costs of training, operation, maintenance, troubleshooting and repair; overlooked rebuild or replacement costs; increased outages, down time and production loss; increased insurance; cost of electrical coordination; overlooked mechanical and structural considerations; and unanticipated currents. To illustrate the foregoing problems, some case studies are provided. In most cases, these problems could have been avoided by performing a little research during the design process.

48108 **Hot boiler feedwater for textile finishing.** Witt, H.S.; Johnston, L.L. (Graniteville Co.). pp 119-122 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

This paper describes a water and energy conservation program implemented at the Graniteville Company, producers of cotton blend fabrics for the apparel trade. Steam supply delivered from the Stevens Steam Plant and water supply for operations drawn from Horse Creek were found to have excess capacity, so a plan was developed to heat boiler feedwater and send the excess back to the Stevens Plant. The hot water feedwater system is schematicized, and the savings provided by the new arrangement are estimated.

48109 **A comparative analysis of heat recovery alternatives for web-offset printing.** Jackson, J.H.; Desmond, R.M.; Lints, M.C. pp 123-127 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

Web offset printing, like many other printing and coating operations, requires a hot air drying process. In most instances, only a small portion of the available heat energy is being utilized. A major portion of this energy is exhausted to atmosphere with the solventladen air stream. This study evaluates various methods to recover and effectively utilize the waste heat. In order to recover the waste heat, solvents that are present in the exhaust air must be removed. Thermal and catalytic oxidation systems are compared based on capital cost and fuel requirements. Solvents concentration controls are discussed in terms of their effect on equipment size and operating costs. Three methods of utilizing the waste heat are considered: direct air recirculation, absorption cooling, and space heating. The energy savings are given for each type of system. A series of plots show how flow rate, operating hours and unit energy costs affect the economic benefits of these heat recovery alternatives.

48110 **Saving electrical energy by reducing mechanical loads.** Katz, J.M. pp 321-326 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

Hamilton Standard has reduced energy used per unit of output by 67% since 1972. This paper explains some areas of mechanical engineering an electrical engineer must explore in order to find additional energy saving opportunities in this energy conscious environment. Specific projects implemented as a member of the energy engineering group are outlined. Project emphasis is on application of centrifugal fan and pump laws. An existing energy management system is utilized for cost effective speed control and monitoring. The important interrelationship of electrical and mechanical systems in these projects is also reviewed.

48111 **Energy saving fans.** Monroe, R.C. pp 377-381 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

This paper discusses ways to minimize power consumption of axial fans in air coolers or cooling towers. Efficiency improvements in four areas are examined: the fan itself, the drive system, the fan's environment, and the fan's operating point. The pro's and con's of variable pitch vs variable speed are discussed.

48112 **Conserving gas and saving money with indicating gas flowmeters.** Stenzel, W.I. pp 385-394 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

This paper contains a summary of hints of how to conserve gas and save money with indicating gas flowmeters. On the basic level, the gas inflow through the burner must be correct for the heating job required, and the correct quantity of air is necessary to supply to the burner. A four step process on how to select flowmeters is given. Various types of the basic system are reviewed: atmospheric inspirator, aspirator type mixer, constant pressure mixing system, variable pressure mixing system, blower mixer, carbureator type mechanical mixer, are surveyed. Questions and answers on indicating gas flow meters are also included.

48113 **Augmented air conditioning reduces energy consumption.** Gravenstreter, T.E. pp 91-93 of Advances for energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

This paper studies improvements in adsorptive drying techniques in air conditioning systems which have succeeded in reducing the heat of regeneration from 2200 BTU per pound of water removed to a nominal 1800 BTU per pound. Under the trade name DRY TEMP, standard elements of both adsorptive drying and conventional refrigeration compressors work in a team manner to reduce the energy cost of aid conditioning. The system elements are shown in a schematic view, and the air flow in the system is charted.

48114 **Energy conservation through testing, adjusting, and balancing.** Bisesi, P.J. pp 87-89 of Advances for energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

This paper reviews various approaches which can be used in testing, adjusting, and balancing heating, ventilating, and air conditioning systems so that they perform in accordance with the design intent. Reduction of fan speed, the reduction of refrigeration machine capacity to average requirements, reducing light levels, weatherstripping the building, addition of a recording wattmeter, and other steps are recommended. Two basic devices for measurement of energy use--pressure/temperature taps and pitot tubes--are also studied. In summary, reengineering is found to be the most cost effective step in energy management.

48115 **A multi-fuel boiler system at a major yarn spinning and dyeing company.** Kaskey, G.T. pp 75-76 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

This paper describes the new boiler plant installed by Piedmont Processing in 1982, and built by Energy Systems Inc (ESI). ESI analyzed shared savings methods and helped choose the best method of financing the project. In order to reduce fuel costs a multi-fuel boiler project was pursued and payback calculations based on actual fuel bills from old boilers were compared with cost of producing the same amount of steam with fuels such as coal. The Piedmont boiler facility as installed is described, with attention paid to the coal delivery system. A burner mounted on each boiler can also handle natural gas and fuel oil. Savings of the system are being documented, and details can be obtained by contacting ESI.

48116 **New combination--fuel boiler reduces plant fuel costs and purchase power requirements.** Price, D.M. pp 65-73 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

This paper describes efforts by the Weyerhauser Company's Plymouth, North Caroline Fiber complex to reduce costs by installing a No. 1 Hog fuel boiler of a higher pressure/temperature design in order to increase in-plant electrical generation. A No. 5 Recovery boiler with state-of-the-art pressure levels for recovery boilers was installed to maximize the potential for back-pressure power. The arrangement of these boilers are schematicized, as are the main steam system flow, bark/wood waste system flow, coal system flow, combustion air system flow, and flue gas system flow. Details of the startup and operation are given, and problem areas encountered including bark/wood waste fuel distribution, coal feed pipe pluggage, inability to burn coal with nozzles in the closed position, and inadequate windbox-to-furnace differential air pressure are discussed.

48117 **Applying oxygen trim control of small packaged commercial boilers.** Nelson, R.L. pp 53-64 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

Recent trim control analysis of air-fuel ratios, which make possible the continuous automatic optimization of burner performance, are studied in this paper. First, the requirements for small boiler control are discussed. An oxygen trim control system applied to a jackshaft type boiler or heater is described. The trim mechanism is illustrated. An oxygen trim control using fuel trim is also schematicized. Bias vs. ratio trim, static vs dynamic trim control, programmed oxygen set point, multiple fuel firing, oxygen measurements, and operator interface are problems which are dealt with by means of microprocessor trim control.

48118 **Small scale cogeneration systems.** Parker, S.A.; Froneberger, R.L.; Thompson, C.R.; Turner, W.C. pp 17-24 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

Cogeneration is defined as the coincident generation of necessary heat and power-electrical and/or mechanical-or the recovery of excess heat for power production. The concept of cogeneration is not new. In the early 1900's, 58% of on site power was cogenerated. Since then, and up until the mid 1970's, cogeneration dropped to 5%. Today, however, with the rapidly increasing energy costs, cogeneration is gaining in popularity. Unfortunately, only the largest of industrial energy consumers appear to be investing in cogeneration. This paper is designed to develop a basic understanding of cogeneration as it applies to small applications. Recognizing that there is a large potential for cogeneration systems 500KW and smalier, this paper is designed to aid the plant engineer in the basic understanding and application of small scale cogeneration. The paper presents the basic legal, environmental and technical factors necessary to introduce the concept of cogeneration. Each of the methods is first described with a brief discussion of the application and any special factors that should be considered. Then, an economic analysis is presented. The paper concludes with a hopeful outlook on the future of small scale cogeneration.

48119 **The state-of-the-art of chemical heat pumps for waste heat recovery in the process industries.** Suciu, D.F.; Ally, M.R.; Rebello, W.J. pp 129-133 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

This paper presents the results of a worldwide survey to determine the state-of-the-art for chemical heat pump systems. The survey results show that absorption chemical heat pump systems ($LiBr/H_2O-NH_3/H_2O$) are commercially available but are limited at high temperature due to corrosion and the high pressure of the those systems. Sulfuric acid-water and metal hydride chemical heat pump systems have been demonstrated in prototype units with delivery temperatures in the 350-400°F range. Other systems, barely beyond the concept stage, appear to have potential to achieve delivery temperatures of 350-500°F.

48120 **Economic attractiveness of cogeneration technologies for the industrial steam user.** Whiting, M.; Decker, G.L. pp 445-452 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

This paper studies the advantages and disadvantages of cogeneration. The advantages include high efficiency, lower capital cost, continued improvement of the technology, and environmental advantage; the disadvantages include its complexity, constraints it imposes on plants, lack of experience, substantial capital investment required, and continued opposition by utilities to its use. An economic evaluation of cogeneration is given, and four types of third-party financing are described.

48121 **Steam trap application.** Murphy, J.J.; Hittner, H.; Scott, J. pp 487-498 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

The effective application of steam traps encompasses three primary areas which are the selection and sizing, the installation, and the monitoring of the steam trapping system. Proper application of steam traps, which remove air and condensate, respond to load and pressure changes, and limit steam flow, will improve production rates, product quality, and reduce energy and maintenance costs. This paper deals with defining the type of service, outlining system parameters, steam trap sizing, proper installation, and system monitoring techniques.

48122 **Energy cost reduction by eliminating waste.** Kumar, R. pp 115-118 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

This paper deals in depth with the waste energy reduction methods suitable for industrial, commercial, and institutional facilities and their economic analyses. The energy manager must evaluate three waste energy parameters in developing waste energy recovery/reduction projects: source/use (sink), quality, and quantity.

Several off-the-shelf devices that can be used to reclaim waste energy to reduce or eliminate waste energy in a facility are introduced, including: the shell and tube heat exchanger, rotary air-to-air energy exchanger, heat pipe exchanger, fixed, air-to-air exchanger, run-around recovery systems, waste heat boilers, thermal storage, refrigeration heat of rejection, boiler flue gas, and others. Finally, an economic analysis of such equipment is given.

48123 **Are power exchange services available to cogenerators?.** Brand, W.E. pp 47-50 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

This paper studies the concepts of "firm power" and "power exchange services". System diagrams for firm power for isolated systems with large, medium, and small units are given. This kind of system planning is a compromise between economies available from increasing unit size and diseconomies of large fixed costs of reserves because of idle reserve capacity. "Reserve sharing", a way to minimize the cost of idle reserves and still use large units, by showing how interconnection reduces the percentage of reserves required to maintain the same assurance of firm power. The general requirements of reserve sharing arrangements are outlined. Finally, the part that FERC's policies may have in providing industrials the opportunity to obtain such power exchange services is reviewed.

48124 **Environmental assessment of gas-fueled cogeneration.** Kurzynske, F.R.; Cummings, C.R.; Hanson, E.W. pp 41-45 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

Preliminary results reflective of a general overview of a project by the Gas Research Institute to analyze the environmental issues associated with cogeneration are described in this paper. A review of the environmental regulatory requirements includes a listing of all state-level environmental policy acts and energy facility siting laws, emissions performance, air quality impacts, control technology, plus the effects of NOX control techniques for reciprocating engines, and a comparison of emission rates from typical fuel-burning sources are also studied.

48125 **Cogeneration - An energy conservation and cost savings approach.** Gupta, V. pp 33-39 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

The benefits of cogeneration include efficient energy utilization, conservation of non-renewable fuels, reliable electricity supply, and stabilization of energy costs. In addition, cogeneration provides the flexibility of using alternate fuels such as nuclear energy, solar energy, biomass or waste materials, or any other viable source of thermal energy. This paper will describe thermodynamics of cogeneration, various approaches to cogeneration, their impact and economic feasibility, and constraints on development and implementation of cogeneration. Recent developments such as trigeneration, combined gas cycles, and nuclear cogeneration will also be discussed. The possible candidate industries that can use cogeneration will also be pointed out. Potential energy savings and potential of cogeneration in future will also be mentioned.

48126 **Advances in energy cost savings for industry and buildings.** Atlanta, GA, USA; Fairmont Press (1983). 498p. (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

The papers in this book are based upon presentations made at the 6th World Energy Engineering Congress, Nov 29-Dec 2, 1983. Topics covered include advances in energy cost savings for industrial plants, energy management strategies and economics, advances in cogeneration, boiler optimization, HVAC energy utilization, alternative technologies, waste heat recovery; plus boiler and furnace efficiency, how to reduce natural gas fuel costs, advances in wood energy technology, and various management and planning problems involved in electrical, industrial, and utility energy utilization.

48127 **Advances in energy cost savings--the Southwire experience.** Holladay, J.F.; Clarkson, J. pp 13-15 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

This paper describes the energy conservation efforts undertaken at the Southwire Company, a major producer of electrical wire and cable in Carrollton, Georgia. The company's major energy projects include trigeneration in the recovery boiler and topping turbine of the copper refinery, development of a more efficient shaft-type copper furnace, retrofitting burners in an aluminum melting furnace, and the use of low head generation, all of which are schematicized. The energy management system layout is also described, and conservation efforts which have resulted in an $8 million estimated avoided cost savings in the past three years are outlined.

48128 **Future of the Department of Energy's coal-conversion program.** Lublin, E.L. (Dept. of Energy, Washington, DC). *Energy Law Journal;* 2: No. 2, 355-368(1981).

A review of the implementation and administration of the Power Plant and Industrial Fuel Use Act of 1978 examines the history and purpose of encouraging the use of fuel other than oil, and of DOE's program to encourage coal conversion. Most conversions have been the result of regulations rather than a voluntary action on the part of industries or utilities. Amendments to the Fuel Use Act under the Reagan administration and efforts to eliminate the Act and allow market forces to determine fuel choice are not desirable. Although the Act could be improved, history shows that a national policy is needed to encourage fuel substitution during periods of surplus and moderate prices. It will be worthwhile to consider and develop new incentives and policies aimed at promoting energy independence. 42 references.

3206 Municipalities And Community Systems

REFER ALSO TO CITATION(S) 32060047751, 48023, 48091, 48124

48129 **(DOE/CS/20238—T1) Evaluation of the feasibility of co-processing sewage sludge with municipal solid waste. Final report.** 10 Mar 1980. Contract FG01-79CS20238. 74p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE84017349.

The feasibility of co-processing sewage sludge with municipal waste in Consumat modular controlled-air incinerators is discussed. Attention is directed principally to the effect of sludge addition on waste processing capacity, steam production rates and air quality conditions. Both the quantity of the sludge processed and the moisture content of the sludge are considered as primary parameters.

48130 **(DOE/NBM—4016103) Development of a community energy conservation program. Volume II. Energy saving techniques for use by local governments.** (Urban Systems Research and Engineering, Inc., Cambridge, MA (USA)). 26 Nov 1976. Contract EM-78-C-01-5313. 150p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE84016103.

This volume contains technical material related to community energy conservation programs, and supplements the organizational material in Volume I. It is in looseleaf format so that sections related to specific topics can be easily copied or transferred to individuals responsible for various sorts of conservation, such as carpooling programs, building improvements, and community outreach. Three technical chapters are included, discussing topics in the areas of: internal city and county operations; community powers and regulations, and outreach programs. In the first, the concern is with what the community can do to reduce energy use in its own operations, an effective first step in promoting comprehensive energy conservation. The second chapter analyzes ways that the police power and fiscal powers of the community can be used for energy conservation, through building codes, zoning, and similar measures. In the final chapter, ways to promote energy conservation in the community are discussed: programs include outreach to households and firms, carpool promotion, waste oil recycling, etc.

48131 (PB—84-197292) Monitoring integrated energy systems at a waste water treatment plant in Maine. Fuller, D.R.; Wilke, D.A.; Thomas, P.L.; Lisa, A.J. May 1984. 140p. NTIS, PC A07/MF A01.

A project was undertaken to monitor the performance of an integrated energy system at the Wilton, Maine, waste water treatment plant. These systems included active and passive solar heating, effluent heat recovery, digester gas generation, air-to-air heat recovery, and electricity generation using digester gas. To accomplish the monitoring, an instrumentation system was installed and data were collected over the period from May 1979 to March 1981. This instrumentation system includes solar pyranometers, hydronic BTU computers, electrical and gas meters, a weather station, and numerous temperature transmitters. Data for the solar and digester systems are available in both digital and analog forms.

48132 (TVA/OP/ECR—84/42) Energy management annual report, Fiscal Year 1983. 1984. 85p. NTIS, PC A05/MF A01. File Number DE84901082.

Energy conservation efforts in general operations include programs in the areas of general transportation, industrial operations, utilities operations, and research and development operations and are detailed. Major energy conservation efforts for TVA buildings began in 1973. Conservation efforts for existing, new, and leased buildings are detailed. Related activities include various energy conservation and management programs, demonstration programs, and solar and other renewable resource programs. Energy use data for buildings and general operations are summarized in Appendices 1 through 4.

48133 Economics of utility residential energy-conservation programs: a Pacific Northwest example. Hirst, E.; Goeltz, R. (Oak Ridge National Lab., TN). *Energy Journal;* **5**: No. 3, 159-169(Jul 1984). Contract W-7405-ENG-26.

An assessment of program benefits and costs for the Bonneville Power Administration (BPA) Residential Weatherization Pilot program is presented. The assessment is based on a detailed empirical evaluation of the program, and enough data was collected from both program participants and nonparticipants to analyze the actual energy savings that could be attributed to the BPA program. This information was also used to compute the Net Present Worth (NPW) of the program from the perspectives of the program participants, the BPA power system, and the Pacific Northwest region as a whole. 17 references, 1 figure, 2 tables.

48134 Control of glass in waste-to-energy production. Peirce, J.J.; Saul, C.S. (Dept. of Civil Eng., Duke Univ., Durham, NC). *Journal of Energy Engineering;* **110**: No. 1, 22-35(Mar 1984).

Mechanisms that contribute to glass contamination of waste-to-energy products from air classifiers are studied, and modifications to unit processes are suggested. Vertical air classifiers are used to extract the combustible organic fraction from municipal solid waste (MSW); however, unit operations preceding these classifiers tend to produce glass particles which, despite a relatively high density, tend to move with the organics once they reach the classifier. Experience in burning waste-to-energy fuel indicates critical problems are associated with the presence of these inorganic fines in the fuel, including excessive slagging on incinerator walls and abrasion of mechanical parts. This research investigates the relationships between glass particle size and air velocity within the classifier, and details the effects paper particles and moisture have on glass particle transport. Laboratory results lead to conclusions which suggest changes in the operation of air classifiers, and imply designs for selected unit operations which precede the classifiers.

48135 Recycling plastic wastes: quantity projections and preliminary competitive assessment. Curlee, T.R. (Oak Ridge National Lab., TN). *Materials and Society;* **8**: No. 3, 529-549(1984). Conctract W-7405-ENG-26.

Projections of the quantities and qualities of specific plastic resins in the municipal waste stream in the years 1985 and 1990 are presented. In addition, the paper reviews and summarizes the literature in which net cost and net revenue estimates are made for selected disposal and recycle technologies. Three preliminary conclusions are drawn. First, during the 1985-1990 time period, only about 25% of the total quantity of plastic wastes can be easily diverted from the municipal waste stream. Second, the data currently available indicate that several recycle processes are competitive with currently used disposal processes. Third, recycle processes that utilize municipal wastes are not clearly inferior to recycle processes that utilize relatively uncontaminated plastic wastes. 22 references, 1 figure, 10 tables.

48136 Removing uranium from drinking water by metal hydroxides and anion-exchange resin. Lee, S.Y.; Bondietti, E.A. (Oak Ridge National Laboratories, Oak Ridge, TN). *Journal, American Water Works Association;* **75**: No. 10, 536-540(Oct 1983).

Results of bench-scale testing on uranium removal from a natural water that was chosen as a good representative of uranium-bearing waters indicated that conventional coagulant and lime softening treatment removes more than 85 percent of dissolved uranium (83 μg U/L) when an optimum pH and dosage were provided. A strong base anion-exchange column is a recommended option for the treatment of private well waters containing uranium at higher than desirable levels.

48137 Teamwork pays off for Washington State. James, J.W.; Hochsteller, C.; McCoy, G. pp 475-478 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

The Washington State Energy Office pilot program to bring together a team of energy professionals to comprehensively assess and help to solve the energy problems of local governments is described from the beginning of the process to the end. Several examples from local governments illustrate the type of energy conservation or generating projects with which the Local Government Technical Assistance Team has been involved. Application to industry, and successes and failures are also touched upon.

48138 Transferability of direct load control program results and experience. Moskovitz, M.; Beardsworth, E.; Haas, S.; Hirshberg, A. pp 345-350 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

This paper details a project which represents an intial effort to establish a method for transferring direct load control results among utilities. The project's objectives are to explore nonexperimental methods to predict direct load control impacts, and to develop a methodology to transfer DLC load impact estimates and project experience among utilities, The Project has been organized into three phases, data collection and screening, transfer analysis, and DLC data transfer. Results to date in the various areas of the project are summarized.

48139 Energy management practices at County Sanitation Districts of Orange County, California. Knopf, G.W.; Clarke, W.M. pp 471-473 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

This paper tracks the County Sanitation Districts of Orange County wastewater treatment process energy management program over the last 25 years. The program is a multilevel program that results in an annual energy savings of over 5 million dollars in 1983.

3209 Education And Public Relations

REFER ALSO TO CITATION(S) 32090048090, 48094, 48130

48140 **(DOE/CS/60014—4) Energy-saving ideas for employers from the 6th annual energy saver's award of excellence competition.** [1984]. Contract FG02-76CS60014. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84017579.

This booklet profiles the innovative, cost-effective energy conservation measures adopted by the entrants in this year's competition. The 1981 entrants are listed and the judging process is described. The winners and runners-up are listed and their projects are described briefly. (MHR)

48141 **(DOE/CS/60014—5) Energy-saving ideas for employers from the 7th annual energy saver's award of excellence competition.** [1984]. Contract FG02-76CS60014. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84017578.

This booklet profiles the innovative, cost-effective energy conservation measures adopted by the 26 entrants in this year's competition. The 1983 entrants are listed and the judging process is described. The winners and runners-up are listed and their projects are described briefly. (MHR)

48142 **The Los Alamos National Laboratory's Educational Outreach Program.** Sandoval, A.E.; Berg, D. (Los Alamos National Laboratory, P.O. Box 1663, Los Alamos, NM 87545). *Transactions of the American Nuclear Society;* **46**: 30-31(Jun 1984). (CONF-840614—).

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

3301 Internal Combustion Engines

REFER ALSO TO CITATION(S) 33010048156, 48157

48143 **(AD-A—141418/4) Wall effects on combustion in an engine. Final report 15 March 1983-14 May 1984.** Fendell, F.E. 14 May 1984. 9p. NTIS, PC A02/MF A01.

This project utilized theoretical modeling and laboratory experiment to elucidate the role of chamber shaping on the combustion event in a four-stroke-cycle, reciprocating-piston-type internal-combustion-engine cylinder. First, theoretical modeling was carried out to evaluate heat transfer as a determent of end-gas knock during nonisobaric flame propagation across a homogeneous charge in a variable-volume enclosure. Via a semi-empirical model, turbulent combustion in an automotive cylinder was considered; a three-zone generalization (to encompass end gas, unburned bulk gas and burned gas) of the standard two-zone Otto-cycle-combustion model was developed. Via a selfcontained model, laminar combustion in a specially designed rapid-compression machine was considered; an asymptotic analysis valid in the limit of large Arrhenius activation temperature was developed. For given operating conditions, the fraction of the charge (if any) that undergoes autoconversion to product prior to flame arrival can be ascertained, along with the heat transfer sufficient to preclude such homogeneous explosion. Second, two-wall, or crevice-type, quenching of flame propagation through a stoichiometric or fuel-lean hydrocarbon-air-type premixture is examined because this phenomenon is now believed to be the major source of unburned-hydrocarbon emissions from homogeneous-charge engines.

48144 **(DOE/NASA—0030-1) Steam bottoming cycle for an adiabatic diesel engine.** Poulin, E.; Demler, R.; Krepchin, I.; Walker, D. (Foster-Miller Associates, Inc., Waltham, MA (USA)). Mar 1984. Contract AI01-80CS50194. 128p. (NASA-CR—168255). NTIS, PC A07/MF A01. File Number DE85001318.

A study of steam bottoming cycles using adiabatic diesel engine exhaust heat projected substantial performance and economic benefits for long haul trucks. A parametric analysis of steam cycle and system component variables, system cost, size and performance was conducted. An 811 K/6.90 MPa state-of-the-art reciprocating expander steam system with a monotube boiler and radiator core condenser was selected for preliminary design. When applied to a NASA specified turbo-charged adiabatic diesel the bottoming system increased the diesel output by almost 18%. In a comparison of the costs of the diesel with bottoming system (TC/B) and a NASA specified turbocompound adiabatic diesel with after-cooling with the same total output, the annual fuel savings less the added maintenance cost was determined to cover the increased initial cost of the TC/B system in a payback period of 2.3 years. Also during this program steam bottoming system freeze protection strategies were developed, technological advances required for improved system reliability were considered and the cost and performance of advanced systems were evaluated.

48145 **(DOE/NASA/50194—38) Baseline performance and emissions data for a single-cylinder, direct-injected, diesel engine.** Dezelick, R.A.; McFadden, J.J.; Ream, L.W.; Barrows, R.F. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Sep 1984. Contract AI01-80CS50194. 65p. (NASA-TM—83638). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85001321.

This report documents comprehensive fuel consumption, mean effective cylinder pressure, and emission test results for a supercharged, single-cylinder, direct-injected, four-stroke-cycle, diesel test engine. Inlet air-to-exhaust pressure ratios were varied from 1.25 to 3.35 in order to establish the potential effects of turbocharging techniques on engine performance. Inlet air temperatures and pressures were adjusted from 34° to 107°C and from 193 to 414 kPa to determine the effects on engine performance and emissions. Engine output ranged from 300 to 2100 kPa (brake mean effective pressure) in the speed range of 1000 to 3000 rpm. Gaseous and particulate emission rates were measured. Real-time values of engine friction and pumping loop losses were measured independently and compared with motored engine values.

48146 **(LBL—18163) Knock syndrome: its cures and its victims.** Oppenheim, A.K. (Lawrence Berkeley Lab., CA (USA)). Jul 1984. Contract AC03-76SF00098. 11p. (CONF-8410138—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE84016884.

From SAE fuels and lubricants meeting; Baltimore, MD, USA (8 Oct 1984).

The problem of knock is traced back to the earliest scientific paper on combustion in premixed gases written by Mallard and Le Chatelier. The pioneering contributions of Ricardo, Kettering and Semenov are then put in proper perspective. Upon the recognition of the fact that this phenomenon has been, and still is, imposing the major technological constraint upon the automotive and oil industries, its various cures are reviewed. Essential features of combustion instability leading to its onset are then exposed, and the methodology is outlined for a rational attack upon the problem it poses.

48147 **(PB—84-205681) Opportunities for automobile fuel economy arising from new technology and design.** Cousins, S. (Open Univ., Milton Keynes (UK). Energy Research Group). Feb 1984. 37p. (ERG—046). NTIS, PC E04/MF E04.

Technological and design changes to automobiles are assessed for their contribution to reduce (future) fossil fuel demands within the OECD area. Factors considered include, weight reduction, body shell design, new materials, modifications to the Otto cycle engine, other engine types, improved power train systems and drag reductions. No one factor is seen as dominant in achieving fuel economy except the order of magnitude saving from designing less powerful auto's. The car-driver interface is examined for fuel saving potential. Novel hybrid car systems, such as the OECD two-car strategy are also outlined.

48148 **(PB—84-214618) Utilisation of exhaust gas heat of transport vehicles: study. Final report.** Finger, H.; Ecke, K.; Jungbauer, L.; Heuer, J. (Commission of the European Communities, Luxembourg). 1983. 116p. (In German). (EUR—8505-DE-EN). NTIS, PC E06/MF E06.

Summary in English.

The present study was intended to estimate the fuel savings for a Diesel-Rankine compound engine in comparison to a Diesel engine with the same output (206 kW) for a European route and to estimate its profitability. The working fluid for the Rankine bottoming cycle was Fluorinol-50. The adiabatic Diesel engine with bottoming cycle was also included in these considerations as the theoretical limit. The fuel consumption for a 38 t long haul tractor/trailer vehicle was calculated for a route profile corresponding to the route Rotterdam-Verona on the basis of the calculated output and fuel consumption graphs for the compound engines and the Diesel engine.

48149 **Ignition delay and heat release analysis of an ethanol fumigated turbocharged diesel engine.** Gao, X.; Borman, G.; Chen, Z.Ye.; Foster, D. (Department of Mechanical Engineering, University of Wisconsin - Madison, Madison, WI). pp 321-329 of Technical economics, synfuels and coal energy symposium. Dicks, J.B. New York, NY, USA; A.S.M.E. (1984). (CONF-831111—).

From ASME winter annual meeting; Boston, MA, USA (13 Nov 1983).

A turbocharged, open chamber diesel engine was fumigated with prevaporized ethanol and run over its speed and load range. The mass percentage of ethanol was varied from zero to 80% at light load and zero to 50% at full load. Digitized cylinder pressure data were cycle averaged and used to examine ignition delay and to calculate heat release patterns and NO production. It is shown that the ignition delay is increased by the thermodynamic effects of fumigation, but it can be decreased by chemical effects of alcohol reactions if the cylinder gas temperature is above approximately 900 K (1600°R). The heat release model uses three zones; a diesel fuel-ethanol zone, an air-ethanol zone and a products zone. The model predicts that fumigation causes a large increase in the initial burning spike even when the fumigation decreases the ignition delay. Fumigation decreases combustion duration slightly at heavy load but greatly increases the duration at light loads. Values of NO concentration computed from the product zone properties and Zeldovich kinetics predict the observed exhaust NO trends, but are about twice too high in value.

3302 External Combustion Engines

REFER ALSO TO CITATION(S) 33020048148

48150 **(DOE/NASA—0032-23) Automotive Stirling Engine Development Program. RESD Summary report.** May 1984. Contract AI01-77CS51040. 215p. (NASA-CR—174674). NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE85001322.

This is the final report compiling a summary of the information presented and discussed at the May 1983 Automotive Stirling Engine (AES) Reference Engine System Design (RESD) review held at the NASA Lewis Research Center. The design of the engine and its auxiliaries and controls is described. Manufacturing costs in production quantity are also presented. Engine system performance predictions are discussed and vehicle integration is developed, along with projected fuel economy levels.

48151 **(MTI—84-SESD-14) Automotive Stirling Engine Market and Industrial Readiness Program (MIRP). Final report for Phase IA, September 15, 1982-July 31, 1984.** Aug 1984. Contract AC02-80CS50214. 20p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84017263.

A brief history of the project is presented. Included in appendices are the scope of work, management and cost plans, major milestones, and the digital engine control spare parts' list. (MHR)

3303 Electric-powered Systems

REFER ALSO TO CITATION(S) 33030047897

48152 **(DOE/NV/10042—1) ElectriFleet Project. Final report.** Burkhart, C.H.; McDaniel, G.M.; Morgan, J.M.; Horne, M.J.; Davis, R.D. Aug 1984. Contract FC08-79NV10042. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85001598.

The City of Greenville operated and evaluated 15 electric vehicles from July 1980 through June 1983. Four Battronic minivans and 11 EVA station wagons were operated by eight different departments, serving widely varying administrative needs. The project goals were: (1) to conserve petroleum fuel, (2) to learn electric vehicle technology, (3) to enhance public awareness of electric vehicles, (4) to evaluate the feasibility and effectiveness of electric vehicles, and (5) to achieve a net financial saving for the City. This report addresses these goals and discusses why these goals were or were not met in sections devoted to management, costs, operating data, maintenance, operator acceptance, and public awareness.

48153 **(TVA/OP/EDT—84/29) Electric vehicle battery test plan and results.** Blickwedel, T.W. (Tennessee Valley Authority, Chattanooga (USA). Div. of Energy Demonstrations and Technology). May 1984. 217p. NTIS, PC A10/MF A01. File Number DE84901972.

This test plan describes methods and procedures used in testing EV batteries at TVA. Each individual module and vehicle battery pack is given an identification that is traceable through its history. Computer-controlled battery capacity testing equipment is used. Three types of tests are performed - acceptance, in-vehicle, and static load. Records of tests are maintained on the forms illustrated and on computer-generated outputs shown.

3304 Hybrid Systems

48154 **(DOE/CS/54209—18) Hybrid Vehicle Program. Final report.** (General Electric Co., Schenectady, NY (USA). Corporate Research and Development Dept.). Jun 1984. Contract AI01-78CS54209. 208p. (JPL—9950-912). NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE85000326.

This report summarizes the activities on the Hybrid Vehicle Program. The program objectives and the vehicle specifications are reviewed. The Hybrid Vehicle has been designed so that maximum use can be made of existing production components with a minimum compromise to program goals. The program status as of the February 9-10 Hardware Test Review is presented, and discussions of the vehicle subsystem, the hybrid propulsion subsystem, the battery subsystem, and the test mule programs are included. Other program aspects included are quality assurance and support equipment. 16 references, 132 figures, 47 tables.

48155 **Testing and evaluation of EV-1300 lead-acid modules for the hybrid vehicle application.** Corp, D.O.; Gay, E.C.; Hayes, E.R.; Hornstra, F.; Webster, C.E.; Yao, N.P. (Tellabs Inc., Lisle, IL). *SAE (Society of Automotive Engineers) Preprint;* **840474**: 6(Feb 1984).

This paper presents the results of testing and evaluation of GE/Globe EV-1300 lead-acid modules developed by Globe Battery Division of Johnson Controls, Inc., for the hybrid vehicle, HTV-1, developed by General Electric (GE) for the Department of Energy. The design of this battery was derived from that of the Globe Improved State of the Art (ISOA) battery under development for the ETV-1 all-electric vehicle. Key differences in the battery performance requirements for the HTV-1 hybrid vehicle, as opposed to the ETV-1, are higher specific power (137 W/kg versus 104 W/kg sustained for 15 seconds at 50% depth of discharge (DOD)) and less specific energy (36.1 Wh/kg versus 37.5 Wh/kg at a 3h discharge rate). Higher battery power is required for two reasons. First, in HTV-1, the battery is a smaller mass fraction of the design vehicle (341 kg battery/about 1800 kg vehicle = about 0.19) compared to the ETV-1 (488 kg battery/ about1660 kg vehicle = about 0.29). Second, the performance requirements for the HTV-1 are referenced to the more-demanding EPA urban driving schedule compared to the SAE J227aD urban driving schedule for the ETV-1. Less specific energy was specified for the HTV-1 to allow the battery developer to concentrate on high specific power; furthermore, petroleum energy is available to achieve extended range. The objective of the hybrid vehicle is to reduce petroleum consumption in overall driving.

3307 Emission Control

REFER ALSO TO CITATION(S) 33070048143

3308 Alternative Fuels

48156 **(DOE/CS/50023—T1) Project management for the reliability fleet testing of alcohol/gasoline blends. Monthly progress report, September 1979.** 15 Oct 1979. Contract AC03-79CS50023. 19p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84016694.

The report (1) provides a brief review of the project background, objectives, and approach, (2) presents the status of progress through September 30, 1979, and (3) summarizes the expenditure status. A summary of contractual task assignments is provided in Appendix A, and a history of principal reporting activities is provided in Appendix B.

48157 **(DOE/NASA—0327-1) Advanced onboard storage concepts for natural gas-fueled automotive vehicles.** Remick, R.J.; Elkins, R.H.; Camara, E.H.; Bulicz, T. Jun 1984. Contract AI01-81CS50006. 137p. (NASA-CR—174655). NTIS, PC A07/MF A01; GPO Dep. File Number DE85001144.

The objective of this study was the evaluation, both through experimentation and a literature review, of several advanced concepts for storing natural gas at reduced pressure. The advanced concepts included adsorption on high surface area carbon, adsorption in high porosity zeolite, storage in clathration compounds, and storage by dissolution in liquid solvents. Results indicated that high surface area carbons with high packing density were the best low pressure storage mediums. A simple mathematical model was used to compare adsorption storage on a state-of-the-art carbon with compression storage. The model indicated that a vehicle using adsorption storage of natural gas at 3.6 MPa will have 36% of the range, on the EPA city cycle, of a vehicle operating on a compression storage system having the same physical size and a peak storage pressure of 21 MPa. However, preliminary experiments and current literature suggest that the storage capacity of state-of-the-art carbons could be improved by as much as 50%, and that adsorption systems having a capacity equal to compression storage at 14 MPa are possible without exceeding a maximum pressure of 3.6 MPa.

48158 **(NP—4901793) Service trial of waste vegetable oil as a diesel-fuel supplement. Final report.** Engelman, H.W. (Ohio State Univ., Columbus (USA). Dept. of Mechanical Engineering). Oct 1980. 11p. Dept. of Development, Div. of Energy, P.O. Box 1001, Columbus, OH 43216. File Number TI84901793.

Based on the trial of one bus during one school year, the following conclusions were reached. The bend of 20% used deep-frying oil and 80% No. 1 diesel fuel can be run in the 6 to 71 engine without engine modification. Engine deposits were normal and no deterioration of the engine or of the lubricating oil was observed in the trial. There is no significant difference in miles per gallon of fuel between the 20 to 80 blend and straight diesel fuel. The smoke level on the 20 to 80 blend is slightly higher than on straight diesel fuel and decreases as ambient temperature increases. The viscosity of the blend should not be more than approximately 32 SUS. Filter clogging may occur when the ambient temperature falls below 20°F.

36 MATERIALS

REFER ALSO TO CITATION(S) 36000047239

48159 **(DOE/ER/12098—2) Structural characterization of dispersed metal catalysts. Progress report, September 1, 1983-August 31, 1984.** Reucroft, P.J.; De Angelis, R.J.; Bentley, J. (Kentucky Univ., Lexington (USA). Dept. of Metallurgical Engineering and Materials Science; Oak Ridge National Lab., TN (USA)). 24 Aug 1984. Contract AS05-82ER12098. 113p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85001326.

Characterization studies were initiated on four basic dispersed metal systems employing x-ray diffraction transmission electron microscopy and analytical electron microscopy. Systems investigated included Ni/SiO$_2$, Ni/MgSiO$_3$, Au/SiO$_2$ and Co/ZSM-5. The electron microscopy studies on Co/ZSM-5 were initiated in order to confirm previous indications of the presence of high concentrations of basal plane stacking faults in supported cobalt particles. Techniques were developed for investigating small metal particles in porous media and determining the structural characteristics of some catalyst systems of interest. Additional systems of interest were also investigated. Characterization studies have now been carried out on unsupported gold particles and gold particles that have been dispersed in an inert polymeric medium. Compositional and structural changes across regions of interest, such as the interface region between a particle and the support and regions within particles, have been monitored by EDS amd microdiffraction. Characterization studies have been carried out on nickel particles after heating the system to high temperatures (800°C). Modeling studies hae been carried out to simulate contrast effects that can be observed in the dark field images of metal particles. Simulation procedures have been employed to produce x-ray diffraction profiles that are broadened solely due to small particle size. A surface analysis facility has now been developed which employs ion scattering spectroscopy. Surface analysis studies have been carried out on model surfaces.

48160 **(PB—84-193291) Nippon Kokan technical report, number 101, January 1984.** (Nippon Kokan K.K., Tokyo). Jan 1984. 129p. (In Japanese). NTIS, PC E08/MF E01.

See also PB84-193309 through PB84-193333 and PB84-145952.

Contents: Articles--Improvement of internal quality on soft-reduction casting; Development of controlled-rolled type 2.5% Ni steel for low temperature uses; Theoretical analysis on mandrel rolling; An outline of fukuyama No. 3 Electrolytic Galvanizing line; New technology and products of No. 3 continuous galvanizing line at Keihin Works; Seismic reliability of buried pipeline networks (No. 2); Optimum operation of a pipeline system for a geothermal power plant; Performance tests of separator and flasher for geothermal power plant; Nitrogen oxide reduction system for gas engine; Noise prevention measures and prediction program for ship cabins utilizing damping materials; New achievements--NKK-CORAC process; Development of TMT (thermo-mechanical treatment) simulator; Patent introduction.

48161 **(SAND—84-1663C) Substrate preparation for thin film deposition: a survey.** Mattox, D.M. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 15p. (CONF-8408107—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE84016119.

From 6. international conference on thin films; Stockholm, Sweden (13 Aug 1984).

Surface preparation is an integral part of any thin film deposition process. As the technological demands on films and coatings increase, the need for better and more reproducible surface preparation techniques is also increased. There is a wide variety of approaches to surface preparation and each film-substrate couple and function requires specific development. This paper outlines the problems to be considered and some general approaches to surface preparation technologies.

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 36010047290, 47363, 47448, 47534, 47571, 47779, 47780, 47781, 47819, 48203, 48327, 48332, 48354, 48355, 48896, 48911, 48965

48162 (AD-A—141410/1) **Interactions between erosion and corrosion of metals and alloys at elevated temperatures. Final report 5 January 1981-4 January 1984.** Birks, N.; Pettit, F.S. Apr 1984. 36p. NTIS, PC A03/MF A01.

Structural alloys and coating alloys have been developed that successfully resist high temperature oxidation and, to a lesser extent, hot corrosion-depending on conditions. Such protection depends upon the maintenance of a surface layer of oxide that effectively separates the metal from the reactive environment. The oxide protective coatings may however be damaged by erosion by solid particles in the gas flow, the effect being worse when the velocity of the gas flow is high. Unfortunately the detailed mechanisms by which the processes of erosion and oxidation interact at high temperatures are not understood. Much of the work carried out so far has involved studies of the erosion of metals and oxidized metals at room temperature under controlled conditions, or has involved tests at high temperature under conditions designed to simulate those in gas turbines or coal combustors. The data obtained from such tests are well suited to producing reliable comparisons of the behavior of different materials but do not readily lead to analysis of the mechanisms by which erosion and corrosion interact at high temperature. The work described in this report was designed to provide data obtained under well characterized conditions such that understanding could be gained concerning the interaction of erosion and corrosion at high temperatures.

48163 (AERE-R—6939) **Review of the contribution made by microscopy to the study of point defects in bcc metals.** Eyre, B.L. (UKAEA Atomic Energy Research Establishment, Harwell. Metallurgy Div.). Nov 1971. 75p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85900042.

This review paper considers the application of transmission electron microscopy (TEM) and field ion microscopy (FIM) to the study of point defect behaviour in refractory bcc metals. TEM is limited to the study of point defect aggregates and in the first part of the paper we discuss the techniques that have been developed for analysing the geometry and nature of such aggregates, and for assessing their numbers and sizes. FIM has a number of advantages in the study of point defect behaviour stemming from its ability to resolve crystal structure on an atomic scale. On the other hand the observations are made at the specimen surface and this gives rise to a number of interpretational problems. These advantages and difficulties are also discussed briefly in part I. The second part of the paper reviews the experimental information that has been obtained using the two techniques which has a direct bearing on the question of point defect behaviour in bcc metals. A majority of the work has been carried out on irradiated materiels and in the case of TEM molybdenum has received greatest attention, whereas the FIM work has been carried out almost exclusively on tungsten. An attempt is made to relate the microscopy evidence to the large amount of recovery data that has been obtained using bulk physical property measurements. In particular we discuss the various recovery stages in terms of the processes that occur during a particular stage. 106 references, 30 figures.

48164 (BNL—35104) **Magnetic correlations in 3d ferromagnets above T/sub c/.** Shirane, G. (Brookhaven National Lab., Upton, NY (USA)). Jul 1984. Contract AC02-76CH00016. 15p. (CONF-840792—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84016433.

From Workshop on metallic magnetism; Bad Honnef, F.R. Germany (2 Jul 1984).

A review is presented of our current neutron scattering experiments on Fe and Ni above the Curie temperature. Our experimental results show that the picture of propagating spin waves above T/sub c/, widely accepted since 1973, is incorrect. In addition, we will demonstrate that over wide ranges of omega, q and temperature, both, Fe and Ni, as well as Pd_2MnSn, follow a simple paramagnetic scattering function of the spin diffusion type. 14 references.

48165 (CONF-840417—2) **Phase formation and stability in the pseudobinary Ni_3Al-Ni_3V alloy system.** DasGupta, A.; Horton, J.A.; Liu, C.T. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85001117.

From High-temperature alloys - theory and design conference; Bethesda, MD, USA (8 Apr 1984).

In order to study the formation of phases and their thermal stability, DSC (differential scanning calorimetry), x-ray diffraction, and optical microscopy were performed simultaneously in the Ni_3Al-Ni_3V pseudobinary alloy system. For the alloy series represented by Ni_3(Al/sub x/V/sub 100-x/), a tetragonal DO_{22} phase was found to form for $x < 10$, and a cubic $L1_2$ phase for $x > 75$ at room temperature. For $10 < x < 75$, the DO_{22} and $L1_2$ phases were found to coexist. Contrary to some theoretical expectations, no complex ordered equilibrium phases formed in this alloy system at any intermediate composition between Ni_3Al and Ni_3V. Measurements of the order-disorder transition temperature, T/sub c/, by DSC, and the associated details of the phase transformations and stability are discussed.

48166 (CONF-840417—4) **Electronic structure of liquid metal alloys.** Nicholson, D.; Chowdhary, A. (Oak Ridge National Lab., TN (USA); Brandeis Univ., Waltham, MA (USA)). 1984. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85000904.

From High-temperature alloys - theory and design conference; Bethesda, MD, USA (8 Apr 1984).

Electronic structure calculations within the effective medium approximation will be used as a basis for discussion of total electronic energies in liquid-metal alloys. Experience gained in investigating the total energies of crystalline metals makes similar studies of structurally disordered metals feasible. An improved understanding of the energetics of the liquid phase will be important in the theoretical construction of high-temperature phase diagrams.

48167 (CONF-841105—31) **Elevated temperature creep behavior of Inconel alloy 625.** Purohit, A.; Burke, W.F. (Argonne National Lab., IL (USA)). Jul 1984. Contract W-31-109-ENG-38. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84015836.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; Washington, DC, USA (11 Nov 1984).

Inconel 625 in the solution-annealed condition has been selected as the clad material for the fuel and control rod housing assemblies of the Upgraded Transient Reactor Test Facility (TREAT Upgrade or TU). The clad is expected to be subjected to temperatures up to about 1100°C. Creep behavior for the temperature range of 800°C to 1100°C of Inconel alloy 625, in four distinct heat treated conditions, was experimentally evaluated.

48168 (CONF-8308132—3) **Orbital effects in actinide systems.** Lander, G.H. (Argonne National Lab., IL (USA)). 1983. Contract W-31-109-ENG-38. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84017480.

From NATO/CAP institute on moment formation in solids; Vancouver Island, Canada (21 Aug 1983).

Actinide magnetism presents a number of important challenges; in particular, the proximity of 5f band to the Fermi energy gives rise to strong interaction with both d and s like conduction electrons, and the extended nature of the 5f electrons means that they can interact with electron orbitals from neighboring atoms. Theory has recently addressed these problems. Often neglected, however, is the overwhelming evidence for large orbital contributions to the magnetic properties of actinides. Some experimental evidence for these effects are presented briefly in this paper. They point, clearly incorrectly, to a very localized picture for the 5f electrons. This dichotomy only enhances the nature of the challenge.

48169 (COO—1198-559) **Thermomigration of Au^{195} and Sb^{125} in gold and Ni^{59} in nickel.** Mock, W. Jr. (Illinois Univ., Urbana (USA)). Oct 1968. 87p. NTIS, PC A05/MF A01; GPO Dep. File Number DE84017367.

Each interface contained a layer of the appropriate tracer and an inert radioactive $Hf^{181}O_2$ marker. During the temperature gradient anneal, the maximum of the tracer profile at the hot interface shifted with respect to the $Hf^{181}O_2$ marker. Heat of transport of Au^{195} in gold was found to be 0.80 +- 0.27 eV. This value supports Huntington's theory. The heat of transport of Ni^{59} in nickel was estimated to be 1.3 +- 7.2 eV. The experimentally determined value of the Sb^{125} heat of transport in gold was -2.02 +- 0.23 eV. This large negative number indicates that the charge carrier-impurity ion interaction is the dominant driving force for Sb^{125} impurity thermomigration in gold. This value compares favorably with the theoretical value for the heat carrier-impurity ion interaction of Q^* = -0.5 eV for antimony thermomigration in silver.

48170 (DOE/ER/12062—T1) Stability of amorphous metals on semiconductor substrates. Final report. Wiley, J.D.; Perepezko, J.H. (Wisconsin Univ., Madison (USA)). Jun 1984. Contract AC02-82ER12062. 52p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE84017256.

Both the diffusion measurements and in situ resistance results for gold-NiNb indicate that relaxation type processes are active in the 300 to 400°C temperature range. The diffusion measurements also suggest no differences for samples relaxed at 570°C for 10 hours and at 500, and 540°C for 5 hours. The nature of the gold NiNb interaction during diffusion annealing requires further study. Also, the fact that the gold forms a plateau concentration in the region of the gold/NiNb interface suggests the existence of a possible metastable equilibrium state between the crystalline phase forming during interdiffusion and the unreacted underlying amorphous film. Finally the diffusion of Ta and amorphous NiTa into an amorphous NiNb film has been examined by RBS. The diffusion process is much slower than gold diffusion into NiNb and no compound formation was observed. After an initial period of about 7 hours at 505°C no further diffusion was detected for the Ta and NiTa overlayers, suggesting the possibility that surface coatings may act to stablize the amorphous NiNb film.

48171 (DOE/ET/10675—T1) Sulfidation-resistant alloy for coal gasification service. Monthly report, October 1-October 31, 1977. Perkins, R.A.; Bhat, M.S. (Lockheed Palo Alto Research Labs., CA (USA); California Univ., Berkeley (USA)). 10 Nov 1977. Contract AC01-76ET10675. 8p. (FE—2299-17). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84017375.

Work on the program except for a few mechanical tests of Phase II candidate alloys has been stopped due to lack of material required for the Phase III evaluation. The program (Phase III) is now a total of five months behind schedule. Progress reports are presented for Tasks I and II, design for sulfidation resistance, and design for mechanical behavior. Some of the accomplishments are: Task I - Samples of an Fe-18Cr-5Al-1Mo-1Hf alloy have been tested in two high pressure runs at IITRI. Two samples showed little attack after 1000 h at 1650°F in the DOE/MPC gas mixture with 1% H_2S. The samples currently are being exposed for a second 1000 h run. Two additional samples have been exposed for 1000 h at 1500°F in a low Btu gas mixture. Details of the test conditions and results were not available at this time and will be presented in the quarterly report next month. Task II - A summary of impact data for Fe-Cr-Al-Mo alloys is presented in graphs 1 to 3. Graph 1 indicates that increasing Al decreases the notch impact strength. However, when compared with graph 2 which shows the differences between 17 and 18 Cr steels at the low Al (4%) level, the effect does not appear to be real. All materials have the same transition temperature based on a 50% reduction in impact strength. The variation in strength at 100°C is not consistent with Al and Cr composition variations and may be a scatter in data due to other composition and structure variables. Graph 3 shows the effect of Mo additions on behavior. Alloys with 2 to 4 Mo have 3 to 6 times the impact strength of the Mo-free alloys at 100°C. Two alloys were analyzed for impurities that could affect impact behavior and results are presented. 1 reference, 3 figures.

48172 (EPRI-CS—3541) Effects of phosphate environments on turbine materials. Final report. Chen, M.C.; Shalvoy, R.S.; Gould, G.C. (General Electric Co., Schenectady, NY (USA). Turbine Technology Lab.). Aug 1984. 128p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI84920532.

An extensive survey of turbine damage has demonstrated much less corrosion related damage with turbines supplied by drum boilers than those supplied by once through steam generators. Since sodium phosphate salts are used extensively in drum boiler water treatment it was hypothesized that the phosphates may inhibit corrosion or stress corrosion cracking caused by common corrosive turbine deposits. In order to test this hypothesis, general corrosion rate, pitting corrosion resistance, and stress corrosion susceptibility of several common turbine materials were determined in aqueous solutions of chloride, hydroxide and phosphate as well as mixtures of these chemicals. Fast and slow potentiodynamic scans were made, pitting potentials measured and extensive slow strain rate testing was carried out on turbine wheel steel, rotor steel and bucket steel. In addition, some deadweight loaded stress corrosion tests were carried out. Sodium phosphates strongly inhibit the pitting corrosion induced by sodium chloride but show only limited inhibition effect on stress corrosion cracking and the general corrosion of the wheel and rotor steels in hot caustic solutions. At low pH, phosphate solutions induce stress corrosion cracking and cause severe general corrosion in the wheel and rotor steels. Based on the results obtained in this study, the hypothesis is probably incorrect.

48173 (INIS-SU—222, pp 70-73) Study of the diffusion mobility of intrinsic and helium atoms in gold films. Khudyakov, A.V.; Barinov, N.N.; Medvedeva, O.G. (AN SSSR, Vladivostok. Inst. Khimii). 1982. (In Russian). NTIS (US Sales Only), PC A06/MF A01. File Number TI84780272.

In Physics of radiation damage and radiation material science.

Behaviour of helium voids and cracks in gold films of thickness about 600 A prepared by magnetron sputtering have been studied by transmission electron microscopy. The gold films were heated directly in the transmission electron microsocope. It was found that self-diffusion coefficient in gold films containing helium increases up to 10^5-10^{11} order of the magnitude in comparison with chemically pure gold films. While annealing from the temperatures of 423 K the appearance and disappearance of voids and crack healing were observed. The observed phenomena are explained by supersaturation of gold films of vacancies, being formed as a result of helium-vacancy complexes decay. A conclusion is made on the considerable influence on the acceleration of diffusion processes in gold films with large content of helium.

48174 (INIS-SU—247) 12. All-union conference on physics of interaction between charged particles and crystals. Proceedings. (Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya SSSR, Moscow; Moskovskij Gosudarstvennyj Univ. (USSR); Moskovskij Gosudarstvennyj Univ. (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki). 1983. 246p. (CONF-8205270—). NTIS (US Sales Only), PC A11/MF A01. File Number DE84780555.

From 12. All-Union conference on physics of interaction between charged particles and crystals; Moscow, USSR (25 May 1982).

Individual papers were indexed separately for the Energy Data Base.

48175 (LBL—17247) Influence of turbulence on erosion by a particle-laden fluid jet. Dosanjh, S.; Humphrey, J.A.C. (Lawrence Berkeley Lab., CA (USA)). May 1984. Contract AC03-76SF00098. 61p. (CONF-841121—4). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE84014365.

From AIChE annual meeting; San Francisco, CA, USA (25 Nov 1984).

Very few investigations on wear by particle impact have accounted for the influence of turbulence on erosion. In this study, the effects of turbulent diffusion on particle dispersion, and hence erosion, are demonstrated numerically. Variations imposed on the level of turbulence intensity in a particle-laden jet impinging normally on a flat wall show a strong dependence of wear parameters on this quantity. Impacting particle velocities, trajectories and surface densities are predicted from Lagrangian equations of motion. Eulerian equations are used to describe fluid motion, with the turbulence viscosity evaluated from a k-ϵ model of turbulence. Nonessential complexities are avoided by assuming one-way coupling between phases and using an adjusted Stokes' drag relation. Numerical calculations reveal that the relative rate of erosion decreases and the location of maximum wear is displaced toward the stagnation point as the turbulence intensity increases. Efforts to remove present model limitations have been hindered by the unavailability of suitable experimental data.

48176 **(MLM—3182(OP)) Consolidation of thermites by pressing and sintering.** Kelly, M.D.; Abney, L.D. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1984. Contract AC04-76DP00053. 11p. (CONF-840867—5). NTIS, PC A02/MF A01; GPO Dep. File Number DE84016943.

From 9. international protechnics seminar; Colorado Springs, CO, USA (6 Aug 1984).

Consolidated thermites can be used as chemical heat sources. Pressing and sintering, a power metallurgy technique, has been developed to consolidate thermite parts with uniform density, composition, and calorific output. These materials are safe to handle, machineable, and generate minimum gas pressure upon reaction. This technique consists of die pressing various compositions of blended thermite powders, then isostatic pressing the parts before sintering to ensure the uniform density of the thermite composites. Parts sintered at various temperatures were examined metallographically for compositional uniformity and to determine whether diffusion between the powders had occurred. Flexure and tensile strength values were obtained to determine the temperature range required to produce strong parts. The coordination of metallography and strength values for various compositions and sintering temperature resulted in data that were used to optimize the fabrication process. Consolidation of thermite by pressing and sintering was found to be a valid process for producing uniform, dense, strong thermite parts.

48177 **(NP—4901880) Development of compacted graphite cast irons from the Fe-C-Al system.** Stefanescu, D.M.; Martinez, F.O. [1984]. 81p. SOMED-Box 6282, Univ. of Alabama, University (Tuscaloosa), AL 35486 $3.00. File Number TI84901880.

It was thought that by completely replacing silicon with aluminum, compacted graphite cast irons with a lower tendency toward developing high nodularity will be possible to cast, since it is recognized that aluminum, as opposed to silicon, is a strong antinodularizer. The possibility of producing this type of iron has been demonstrated by both ladle and in-mold techniques, with either rare-earth metals or magnesium alloys. When magnesium ferrosilicon was used for ladle treatment of Fe-C-Al iron, the chilling tendency was drastically reduced, and section sites as thin as 0.3 inches were produced free of carbides and with nodularities lower than 20%. When the in-mold process was used for treatment, outstanding mechanical properties were obtained, better than those corresponding to Fe-C-Si compacted graphite irons. Also, a wide variety of mechanical properties, corresponding to structures ranging from 80% ferrite to 70% pearlite, were achieved by simply varying the aluminum content of the cast iron.

48178 **(PB—84-193390) Thermodynamics and kinetics of gas nitriding alpha-iron alloys.** Pukkinen, R. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Metallilaboratorio). 1984. 46p. NTIS, PC E04/MF E01.

The current knowledge of the mechanisms of gas nitriding bcc iron alloys was surveyed. Alloys studied in the experimental work were unalloyed and chromium-, molybdenum- and silicon-alloyed alpha-irons. The effects of the surface phases and alloying elements on the kinetics of nitrogenation of alpha-iron were presented. The reasons for the formation of surface iron nitrides under apparently thermodynamically unfeasible conditions were explained. The effect of alloying elements on the distribution of the nitride formation at the iron surface and the effect of alloying elements on grain boundary segregation in bright nitrided alpha-irons were studied. Also the effect of chromium, molybdenum and silicon as alloying elements on the activity coefficient of nitrogen in alpha-iron was presented. (Copyright (c) Valtion teknillinen tutkimuskeskus (VTT) 1984.)

48179 **(SAND—83-2372C) Corrosion research of alloys for use in nuclear waste disposal canisters.** Sorensen, N.R.; Diegle, R.B. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 11p. (CONF-841120—1). NTIS, PC A02; 3; GPO Dep. File Number DE84006292.

From Workshop on corrosion performance of nuclear fuel waste containers; Ottawa, Canada (21 Nov 1984).

All tests involving the corrosion behavior of TiCode-12 (Ti-0.3Mo-0.8Ni) indicate that this alloy is a suitable choice for the containment of nuclear wastes. Although cracking was observed under conditions of hydrogen embrittlement, and pitting occurred in aggressive media, the conditions which produce these two failure modes represented severe overtests and are not expected in a repository. Both Mo and Ni increase the degree of corrosion resistance of Ti alloys. Mo changes the nature of the oxide, while Ni forms intermetallic precipitates which, through galvanic coupling, polarize the Ti into the passive region. All alternate alloys tested (including cast iron) exhibit acceptable corrosion behavior relative to their role as backup canister materials. In the case of cast iron, the material provides for a corrosion allowance design in contrast to the corrosion resistant design offered by Ti alloys. The effects of gamma irradiation still need to be adequately characterized. Research on such effects is underway at Sandia and at the University of Minnesota. 11 references, 5 figures, 1 table.

48180 **(SAND—84-1052C) Ion beam studies of hydrogen in metals.** Myers, S.M.; Wampler, W.R.; Besenbacher, F.; Robinson, S.L.; Moody, N.R. (Sandia National Labs., Albuquerque, NM (USA); Aarhus Univ. (Denmark). Inst. of Physics; Sandia National Labs., Livermore, CA (USA)). 1984. Contract AC04-76DP00789. 36p. (CONF-8409130—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE84017422.

From International conference on surface modification of metals by ion beams; Heidelberg, F.R. Germany (17 Sep 1984).

Methods based on ion implantation and nuclear reaction analysis were used to investigate the behavior of hydrogen isotopes in metals. The binding enthalpy of deuterium (D) at irradiation effects, He bubbles, D_2 bubbles, and metal-oxide interfaces was measured for Al, Fe, Ni, Cu, Pd, austenitic stainless steel, Inconel, and amorphous $Fe_{40}Ni_{40}P_{14}B_6$. The binding enthalpies determined for the pure metals are in excellent agreement with mechanistic calculations based on effective-medium theory and other information. Surface-limited release of D from Fe, stainless steel, and Inconel was measured as a function of temperature and the state of surface oxidation. The release rate was accurately proportional to the square of the D concentration in solution, permitting the results to be expressed in terms of a surface recombination coefficient. This quantity was up to four orders of magnitude greater for an ion-sputtered surface than for a surface with electropolish oxide. The diffusion coefficient and solid solubility of tritium in stainless steel were measured for the first time at the ice point, thereby extending downward by three orders of magnitude the diffusivities available from conventional permeation experiments. Deuterium concentration profiles resulting from electrochemical charging of Incoloy 903 were measured as a function of charging current, thereby providing a direct, systematic calibration of such charging in an austenitic material where conventional permeation measurements are precluded by the small hydrogen diffusion rate.

48181 **(SAND—84-1259C) Metastable phase diagram for Ni-implanted Al and pulse surface melted Al(Ni).** Follstaedt, D.M.; Picraux, S.T. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 4p. (CONF-841157—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE85001792.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1984).

The microstructure of <110> Al implanted with Ni was examined before and after subsequent electron beam pulsed surface melting (65 ns, 1.7 J/cm²). Both processes were done with the Al substrate at room temperature. Implantation at several energies (160 to 15 keV) into a given sample produced a nearly constant measured Ni concentration through a ~ 0.1 μm region below the surface [7]. Such samples with concentrations from 8 to 25 at. % Ni were examined, along with a sample with a peak concentration of 32 at. % Ni.

48182 (SAND—84-1347C) **Implantation of Ti + C for reduced friction and wear of steels.** Follstaedt, D.M. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 22p. (CONF-841117—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE85001606.

From 8. conference on the application of accelerators in research and industry; Denton, TX, USA (12 Nov 1984).

A review of various types of friction and wear tests of ion-implanted steels with 10 to 30 at. % Ti and C shows that the implantation reduces wear and unlubricated friction for every steel examined, even for Hertzian contact stresses in excess of the bulk yield strength. The microscopic information on implanted Fe and steels obtained by TEM, Auger analysis and ion beam analysis is presented, and the near-surface amorphous alloy discovered in similarly implanted Fe is shown to be closely associated with the benefits obtained with the Ti + C treatment of steels. The implanted layer changes the unlubricated sliding wear mode from adhesive to abrasive, and the increased hardness of the amorphous alloy then promotes wear resistance. Recent results suggest that the optimum alloy is obtained by using a high Ti concentration (30 at. %) and by implanting C to produce as thick an amorphous layer as possible.

48183 (UCID—20174) **Electrochemical determination of the corrosion behavior of candidate alloys proposed for containment of high level nuclear waste in tuff.** Glass, R.S.; Overturf, G.E.; Garrison, R.E.; McCright, R.D. (Lawrence Livermore National Lab., CA (USA)). 18 Jun 1984. Contract W-7405-ENG-48. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85001768.

Long-term geological disposal of nuclear waste requires corrosion-resistant canister materials for encapsulation. Several austenitic stainless steels are under consideration for such purposes for the disposal of high-level waste at the candidate repository site located at Yucca Mountain, Nevada. With regard to corrosion considerations, a worst case scenario at this prospective repository location would result from the intrusion of vadose water. This preliminary study focuses on the electrochemical and corrosion behavior of the candidate canister materials under worst-case repository environments. Electrochemical parameters related to localized attack (e.g., pitting potentials) and the electrochemical corrosion rates have been examined. 15 references, 15 figures, 4 tables.

48184 **Copper L/sub 2,3/ near-edge structure in Cu_2O.** Hulbert, S.L.; Bunker, B.A.; Brown, F.C.; Pianetta, P. (Department of Physics and Materials Research Laboratory, University of Illinois at Urbana-Champaign, 1110 W. Green St., Urbana, Illinois). *Physical Review [Section] B: Condensed Matter;* **30**: No. 4, 2120-2126(15 Aug 1984).

We report on high-resolution total-yield measurements of the Cu L/sub 2,3/ absorption edge in Cu_2O using the JUMBO monochromator at the Stanford Synchrotron Radiation Laboratory. Care was taken to prepare the surface of a well-characterized single crystal, rather than use oxidized copper. A comparison was also made with electron-energy-loss spectra (transmission of a thin Cu_2O crystal). Prominent white lines or core excitons appear at the spin-orbit-split Cu L_3 (931 eV) and L_2 (951 eV) thresholds. These edge features are like those observed in CuO (even though the Cu d states are filled in Cu_2O) but are asymmetrically broadened on the high-energy side, probably due to more than one component. The core binding energy is measured by photoemission, and local states are compared with transitions to the continuum. We believe that the strong edge features in Cu_2O can be understood in part as transitions to antibonding molecular-orbital states of the linear O-Cu-O molecular cluster peculiar to copper in the Cu_2O crystal structure.

48185 **Calculated magnetization of iron-cobalt disordered alloys.** Victora, R.H.; Falicov, L.M. (Materials and Molecular Research Division, Lawrence Berkeley Laboratory, Berkeley, California 94720 and Department of Physics, University of California, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **30**: No. 1, 259-262(1 Jul 1984).

The spin polarization of the disordered Fe-Co alloy was calculated using a tight-binding scheme, with single-site, full-orbital interactions treated self-consistently. Disorder is introduced by the use of the virtual-crystal approximation. Excellent agreement with the experimental spin polarization is obtained and the unusual shape of the Fe-Co curve on the Slater-Pauling plot is explained. The magnetization of the Co-rich alloys essentially depends on the number of available d holes, while the magnetization of the Fe-rich alloys is influenced by a relatively weak electron-electron interaction. The intersection of the two effects occurs at approximately 30 at. % Co and produces a maximum.

48186 **Interplay of superconductivity, magnetism, and localization in Mo/Ni superlattices.** Uher, C.; Clarke, R.; Zheng, G.; Schuller, I.K. (Department of Physics, The University of Michigan, Ann Arbor, Michigan 48109). *Physical Review [Section] B: Condensed Matter;* **30**: No. 1, 453-455(1 Jul 1984). Contract W-31-109-ENG-38.

A new experimental relationship between superconductivity, magnetism, and localization is explored in short-wavelength (14 A< or =Λ< or =40 A) sputtered Mo/Ni superlattices. A crossover to a superconducting state is observed for Λ<9 A implying paramagnetic behavior when the Ni strata are four atomic layers thick, or less. All samples show localization effects at liquid-helium temperatures and nonsuperconducting samples develop an unusual resistance plateau below Troughly-equal0.5 K.

48187 **New Ce heavy-fermion system: $CeCu_6$.** Stewart, G.R.; Fisk, Z.; Wire, M.S. (Materials Science and Technology Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] B: Condensed Matter;* **30**: No. 1, 482-484(1 Jul 1984).

We have discovered a new heavy-fermion system, $CeCu_6$, with a large susceptibility (chi = 0.027 emu/mole G at 1.5 K) and a large, temperature-dependent specific heat γ below 10 K that is 840 mJ/mole K^2 at 1.8 K and extrapolates to 1.6 J/mole K^2 at $T = 0$ in analogy with $CeAl_3$. High-field specific-heat measurements agree almost perfectly with a narrow-band picture first proposed for UBe_{13}.

48188 **Quantum-size effects in work functions of free-standing and adsorbed thin metal films.** Feibelman, P.J.; Hamann, D.R. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Physical Review [Section] B: Condensed Matter;* **29**: No. 12, 6463-6467(15 Jun 1984). Contract AC04-76DP00789.

Work functions versus film thickness have been calculated self-consistently for free-standing Al(111), Cr(100), Rh(111), and Au(100) films, and for one- and two-layer films of Au(100) adsorbed on Cr(100). The Al, Rh, and Au films show work-function changes of several tenths of an electron volt, between one and four layers, confirming earlier results for free-electron metals and extending them to transition and noble metals. For two- through five-layer films, the work function of Cr(100) is only weakly dependent on film thickness, owing to the existence of a prominent surface state at the Fermi energy, which stabilizes the charge-density profile in the surface region. Adsorbed films of Au on Cr show no work-function quantum-size effects (QSE), because there are no Au-localized states near the Fermi energy. The large Cr density of states at E/sub F/ makes it easy for the Au and Cr states to mix. In general, metals with low state densities have low surface energies, and are thus not apt to be thermodynamically stable substrates for high-density-of-states metals. Therefore, there is no obvious candidate for a metal on a metal system in which QSE should be observed.

48189 **Magnetic field dependence of impurity-induced muon depolarization in noble metals.** Schillaci, M.E.; Heffner, R.H.; Hutson, R.L.; Leon, M.; Cooke, D.W.; Yaouanc, A. (Los Alamos National Lab., NM (USA)); Dodds, S.A. (Rice Univ., Houston, TX (USA). Dept. of Physics); Richards, P.M. (Sandia National Labs., Albuquerque, NM (USA)); MacLaughlin, D.E. (California Univ., Riverside (USA)); Boekema, C. (Texas Tech Univ., Lubbock (USA)). *Hyperfine Interactions;* **17**: No. 1-4, 351-354(Jan 1984). (CONF-830455—).

From Yamada conference on muon spin rotation and associated problems; Shimoda, Japan (18 Apr 1983).

The authors have measured the magnetic field dependence of the muon depolarization rate up to 5 kOe in AuGd (350 ppm), AgGd (340 ppm) and AgEr (300 ppm). A simple model which includes both dipolar and nearest-neighbor contact interactions between the muon and the magnetic impurity does not fit the data. An axial crystal-field interaction, arising from the electric field gradient induced by the muon at the site of the impurity, is found to dominate the Hamiltonian, and may have a large effect on the field dependence.

48190 **Interplays of μSR, susceptibility and neutron studies on dilute-alloy spin glasses.** Uemura, Y.J. (Brookhaven National Lab., Upton, NY (USA)). *Hyperfine Interactions;* **18**: No. 1-4, 447-451(Jan 1984). (CONF-830455—).

From Yamada conference on muon spin rotation and associated problems; Shimoda, Japan (18 Apr 1983).

Static spin polarization of Fe moments in a spin glass AuFe, determined by zero-field μSR, is compared to an ac-susceptibility measurement below the cusp temperature Tsub(g), and a rather uniform amplitude of the static polarization is pointed out for frozen spins. Completely random orientation of frozen spins is revealed by neutron scattering in a dilute 1% CuMn, and an importance of comparing results of these different methods is demonstrated.

48191 **Spin-glass dynamics determined from muon spin relaxation and neutron spin echo measurements.** Heffner, R.H.; Leon, M. (Los Alamos National Lab., NM (USA)); MacLaughlin, D.E. (California Univ., Riverside (USA)). *Hyperfine Interactions;* **18**: No. 1-4, 457-461(Jan 1984). (CONF-830455—).

From Yamada conference on muon spin rotation and associated problems; Shimoda, Japan (18 Apr 1983).

Muon spin relaxation (μSR) and neutron spin echo (NSE) measurements of magnetic ion correlation times and correlation functions in the spin glass systems CuMn, AgMn, and AuFe are compared. It is found that the μSR and NSE measurements are in excellent agreement both above and below the spin-glass freezing temperatures. The experimental results are compared to recent theories of spin-glass dynamics.

48192 **Muon spin relaxation measurements of spin-correlation decay in spin-glass AgMn.** Heffner, R.H.; Cooke, D.W.; Leon, M.; Schillaci, M.E. (Los Alamos National Lab., NM (USA)); MacLaughlin, D.E.; Gupta, L.C. (California Univ., Riverside (USA)). *Hyperfine Interactions;* **18**: No. 1-4, 463-466(Jan 1984). (CONF-830455—).

From Yamada conference on muon spin rotation and associated problems; Shimoda, Japan (18 Apr 1983).

The field (H) dependence of the muon longitudinal spin-lattice relaxation rate well below the spin glass temperature in AgMn is found to obey an algebraic form given by (H)sup(γ-1), with γ = 0.54 +- 0.05. This suggests that Mn spin correlations decay with time as tsup(-γ), in agreement with mean field theories of spin-glass dynamics which yield γ <approx. 0.5. Near the glass temperature the agreement between the data and theory is not as good.

48193 **Muon spin relaxation in ferromagnetic PdMn.** Dodds, S.A.; Gist, G.A. (Rice Univ., Houston, TX (USA)); Heffner, R.H.; Leon, M.; Schillaci, M.E. (Los Alamos National Lab., NM (USA)); MacLaughlin, D.E. (California Univ., Riverside (USA)); Mydosh, J.A.; Nieuwenhuys, G.J. (Rijksuniversiteit Leiden (Netherlands). Kamerlingh Onnes Lab.). *Hyperfine Interactions;* **18**: No. 1-4, 467-471(Jan 1984). (CONF-830455—).

From Yamada conference on muon spin rotation and associated problems; Shimoda, Japan (18 Apr 1983).

Positive-muon (μ^+) spin relaxation experiments have been carried out in the dilute ferromagnetic alloy Pd + 2 at.% Mn (Tsub(c) = 5.8 K). In the paramagnetic state the inhomogeneous μ^+ linewidth is proportional to the bulk magnetization. Below Tsub(c) the μ^+ linewidth and the width of the μ^+ local field distribution in zero applied field are both in qualitative accord with the Sherrington-Kirkpatrick theory of disordered magnets.

48194 **Estimates of eddy current response to subsurface cracks from 2-D finite element code predictions.** Palanisamy, R.; Thompson, D.O.; Thompson, R.B. (Ames Laboratory, USDOE, Iowa State Univ., Ames, IA). pp 569-577 of Review of progress in quantitative nondestructive evaluation, Vol. 3A. Thompson, D.O.; Chimenti, D.E. New York, NY, USA; Plenum Press (1984). (CONF-830811—).

From Conference on quantitative NDE; Santa Cruz, CA, USA (7 Aug 1983).

This chapter describes an approximate technique to estimate the true response of an eddy current sensor to a finite subsurface crack from the results of two-dimensional calculations. A horseshoe ferrite core eddy current probe is used to detect subsurface flaws in a semi-infinite stainless steel medium. A two-dimensional finite element code is used to compute the response of the probe. The change in coil impedance is calculated using a three-dimensional scattering model. It is determined from a comparison of the two results that the two-dimensional finite element code overestimates the eddy current sensor response by a factor of 10. The desensitization factor can be used in design studies in which the properties of the materials are varied.

48195 **Eddy current test samples, probes, and scanning system.** Rummel, W.; Rathke, R.; Schaller, R. (Martin Marietta, Aerospace Denver Aerospace, Denver, CO). pp 467-475 of Review of progress in quantitative nondestructive evaluation, Vol. 3A. Thompson, D.O.; Chimenti, D.E. New York, NY, USA; Plenum Press (1984). (CONF-830811—).

From Conference on quantitative NDE; Santa Cruz, CA, USA (7 Aug 1983).

This chapter describes an experimental approach consisting of the design and fabrication of low cycle fatigue (LCF) cracks of varying sizes in two different materials (Ti 6-4 and IN 100); the design, fabrication and characterization of eddy current probes (air core and ferrite core); the design and fabrication of a special X-Y scanner system (to include the interface of eddy current instrumentation to effect digital data collection and recording); and the evaluation of signal variations with typical eddy current applications variables. The probe characterization data show that the impedance and phase of the eddy current signal vary in a nonlinear manner which depends on the probe frequency, test material and lift-off effects. Probe characterization will make it possible to use the automatic scanner system with the appropriate probe at the proper operating frequency to obtain noise and signal data over a wide variety of samples, flaw types and sizes, at varying lift-offs.

48196 **SAW NDE techniques for monitoring the growth behavior of small surface fatigue cracks.** Resh, M.T.; London, B.D.; Nelson, D.V.; Ramusat, G.F.; Shyne, J.C.; Yuce, H.H. (Stanford Univ., Stanford, CA). pp 217-227 of Review of progress in quantitative nondestructive evaluation, Vol. 3A. Thompson, D.O.; Chimenti, D.E. New York, NY, USA; Plenum Press (1984). (CONF-830811—).

From Conference on quantitative NDE; Santa Cruz, CA, USA (7 Aug 1983).

This chapter shows how surface acoustic waves (SAW), or Rayleigh waves, can be used to predict the size and normalized stress intensity factor of small surface fatigue cracks. The SAW techniques consists of measuring the reflection coefficient of Rayleigh waves from an isolated surface crack. The method uses SAW wedge transducers to produce the Rayleigh waves and to receive the reflected signals. Theory is summarized which shows how the reflection coefficient of Rayleigh waves can be used to infer the maximum normalized stress intensity factor and depth of a surface crack. The acoustic scattering theory of Kino and Auld is verified in three different materials: Pyrex Glass, 7075-T651 aluminium, and quenched and tempered 4340 steel. SAW reflection measurements of growing surface fatigue cracks provide in-situ feedback concerning crack size, stress intensity factor range, and crack opening behavior during fatigue cycling. Combined SAW and scanning electron microscopy (SEM) analyses of the opening behavior of small surface fatigue cracks are being conducted to investigate the relation between the crack closure stress and SAW saturation stress.

48197 Ultrasonic determination of diffusion-bond strength. Thomas, G.H.; Spingarn, J.R. (Sandia National Laboratories, Livermore, CA). pp 1243-1250 of Review of progress in quantitative nondestructive evaluation, Vol. 3B. Thompson, D.O.; Chimenti, D.E. New York, NY, USA; Plenum Press (1984). (CONF-830811—).

From Conference on quantitative NDE; Santa Cruz, CA, USA (7 Aug 1983).

This chapter describes the techniques used to fabricate and evaluate (destructively and nondestructively) diffusion-bonded specimens. Preliminary results of the ultrasonic diffusion-bonded strength are presented. Ultrasonic interrogation of the bonding plane is combined with advanced data reduction and pattern recognition algorithms for specimens deliberately manufactured with a range of strengths. All of the bonds are tensile tested to failure and the fracture stress is calculated. A computerized ultrasonic research facility is employed for scanning the bond specimens, reducing the acoustic data and developing classification algorithms. Three characteristics are identified which are directly related to the amount of energy reflected by the diffusion bond: the area under the video envelope, the area under the R-F spectrum and the area under the analytic spectrum. Destructive metallographic analysis shows that diffusion bond strength is degraded by numerous small areas of unbondedness.

48198 On life prediction under stress corrosion conditions below K /SUB ISCC/ . Ranjan, R.; Buck, O. (Ames Laboratory, Iowa State Univ., Ames, IA). pp 1251-1258 of Review of progress in quantitative nondestructive evaluation, Vol. 3B. Thompson, D.O.; Chimenti, D.E. New York, NY, USA; Plenum Press (1984). (CONF-830811—).

From Conference on quantitative NDE; Santa Cruz, CA, USA (7 Aug 1983).

This chapter describes a physical model designed for the study of the stress corrosion cracking of Cu-30Zn brass in a nontarnishing ammoniacal solution. The K /SUB ISCC/ is a "threshold" level above which an existing crack will propagate in Region I, in which crack velocity increases very rapidly with the crack-tip stress intensity. In Region II, crack velocity is basically independent of the crack-tip stress intensity until Region III is reached where the crack approaches criticality and the component fails. Efforts to model this situation and to obtain semi-empirical relations of the effects of stress and/or corrosion on the time of incubation, to perform some critical experiments to test these predictions, and to specify the sizes of flaws at which KISCC is reached are described. The implications of the research on the nondestructive evaluation of stress corrosion cracking in the microcrack initiation regime are examined.

48199 Ultrasonic evaluation of carbon steel for deformarion induced microstructural damage. Thomas, G.H.; Emery, A.F.; Goods, S.H. (Sandi National Laboratories, Livermore, CA). pp 1265-1273 of Review of progress in quantitative nondestructive evaluation, Vol. 3B. Thompson, D.O.; Chimenti, D.E. New York, NY, USA; Plenum Press (1984). (CONF-830811—).

From Conference on quantitative NDE; Santa Cruz, CA, USA (7 Aug 1983).

This chapter shows how ultrasonic attenuation can be used to study the relationship between ultrasonic signal loss and cavity formation in steel. The steel was subjected to a duplex heat treatment in order to produce a spherodized microstructure. Tensile tests were performed on an electromechanical, mechanical test frame to strain levels near fracture. Topics considered include ultrasonic data acquisition, reduction, and microstructural analysis. The prepared specimens were examined by scanning electron microscopy. An automated image analysis routine was employed to count and size the number of cavities at different locations (corresponding to various strain levels) within the gage level. Metallographic analysis revealed that the decrease in signal strength corresponds to an increase in void area fraction. It is determined that ultrasonic attenuation is sensitive to the population of deformation induced cavities in the 0.1 μm to 1.5 μm range. Increasing the extent of cavitation results in a decrease in signal strength.

48200 Absolute measurement of stress in textured plates from angular dependence of the SH /SUB O/ mode velocity. Thompson, R.B.; Lee, S.S.; Smith, J.F. (Ames Laboratory, USDOE, Iowa State Univ.). pp 1311-1319 of Review of progress in quantitative nondestructive evaluation, Vol. 3B. Thompson, D.O.; Chimenti, D.E. New York, NY, USA; Plenum Press (1984). (CONF-830811—).

From Conference on quantitative NDE; Santa Cruz, CA, USA (7 Aug 1983).

This chapter compares the velocities of two shear waves whose directions of propagation and polarization have been interchanged in order to measure absolute stress levels. The higher order prediction of the theory of continuous elastic media is applied to polycrystalline metals. Horizontally polarized shear modes travelling in the plane of the plate are excited and detected using EMAT transducers operating at 500 kHz. A 6061-T6 A1 plate and an 1100-H14 A1 plate are studied. The ultrasonic velocity is measured by exciting the transmitter by a tone burst and monitoring, with a time interval counter in the averaging mode, the arrival time of a particular cycle at the receiver. The results on both samples are consistent with the apparent microstructural insensitivity of the examined equations. It is established that the difference in velocities is due to the solid equivalent of the dynamic restoring force which determines the velocity of transverse waves on a taut string. It is concluded that the continuum theory is applicable to the polycrystalline sample as measured at 500 kHz.

48201 Inference of compressive stresses from clamped interfaces with ultrasonic measurements. Rehbein, D.K.; Smith, J.F.; Thompson, D.O. (Ames Laboratory, USDOE, Iowa State Univ., Ames, IA). pp 1321-1329 of Review of progress in quantitative nondestructive evaluation, Vol. 3B. Thompson, D.O.; Chimenti, D.E. New York, NY, USA; Plenum Press (1984). (CONF-830811—).

From Conference on quantitative NDE; Santa Cruz, CA, USA (7 Aug 1983).

This chapter attempts to develop a nondestructive procedure for the determination of the compressive stresses which occur at interfaces between Nitinol couplers and tubing that is joined by the couplers. It is determined that the reflection coefficient for a normally incident ultrasonic wave can be correlated with the stress level at the NiTi-tubing interface. A computer controlled automatic scanning system is used to provide longitudinal and circumferential scanning and stress evaluation capability. Flaw detection experiments are performed using typical in-service defects. It is established that current theory predicts at least semi-quantitatively the effect of stress levels at interfaces on reflection amplitude of ultrasonic echoes. Roughness has a pronounced effect on the intimacy of sonic contact and on echo amplitude. The empirical results show that the measurement of echo amplitudes provides a tool for inferring variations in interfacial stress levels.

48202 Aging response of a welded iron-based superalloy. Strum, M.J.; Summers, L.T.; Morris, J.W. Jr. (Univ. of California, Berkeley). *Welding Research (Miami);* 235.S-242.S(Sep 1983). Contract AC03-76SF00098.

GTA weldments of JBK-75, a superalloy with improved hot cracking resistance, exhibit pronounced differences in aging response and resultant strength level between base and weld metal regions. The iron-based superalloys are primarily age-hardened materials strengthened through precipitation of a fine dispersion of gamma prime, Ni_3Ti, in an austenite matrix. The presence of titanium segregation to dendrite interstices upon weld metal solidification results in a nonuniform aging response within the weld. Although rapid initial precipitation occurs within the weld, a persistent mismatch between the base metal and the lower hardness weld metal is suffered irrespective of aging time. This behavior is explained by the localization of slip occuring within the weld solidification structure. Uniform hardness levels can be obtained with short time, moderate temperature, post weld anneals at 950°C (1742°F) prior to aging.

3602 Ceramics, Cermets, And Refractories

REFER ALSO TO CITATION(S) 36020047303, 48354

48203 (AD-A—141496/0) Mechanical properties of metal hydrides. Technical report. Birnbaum, H.K. (Illinois Univ., Urbana (USA). Dept. of Metallurgy and Mining Engineering). Apr 1984. 23p. NTIS, PC A02/MF A01.

The role of metal hydrides in the hydrogen embrittlement of a number of metal-hydrogen systems is reviewed. The stress induced formation and cleavage of hydrides at crack tips and the thermodynamics of the hydrides in the stress field of the crack tip are discussed. The mechanical response of the hydrides to applied stresses is described. Many of the hydrides exhibit some plastic deformation under favorable stress systems with the amount of this deformation increasing as the temperature of testing is increased. Phonon properties and the elastic moduli of the hydrides are briefly discussed and it is suggested that these parameters do not provide a basis for understanding the mechanical properties of the hybrides. The deformation response of the hydrides is consistent with the expected behavior of dislocations in the ordered hydride structures.

48204 (CONF-831142—3) Dispersed metal-toughened ceramics and ceramic brazing. Moorhead, A.J.; Tiegs, T.N.; Lauf, R.J. (Oak Ridge National Lab., TN (USA)). 1983. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85001552.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

An alumina (Al_2O_3) based material that contains approximately 1 vol % finely dispersed platinum or chromium was developed for use in high temperature thermal-shock resistant electrical insulators. The work at ORNL is divided into two areas: (1) development of DMT ceramics; and (2) development of brazing filler metals suitable for making ceramic-to-ceramic and ceramic-to-metal brazements. The DMT ceramics and brazements are intended for service at elevated temperatures and at high stress levels in the dirty environments of advanced heat engines. The development and characterization of DMT ceramics includes processing (powder preparation, densification and heat treatment) and detailed measurement of mechanical and physical properties (strength, fracture toughness, and thermal conductivity). The brazing work includes: (1) the formulation and melting of small quantities of experimental brazing filler metals; (2) evaluation of the wetting and bonding behavior of these filler metals on Al_2O_3, partially stabilized zirconia and α-SiC in a sessile drop apparatus; and (3) determine the short-term strength and fracture toughness of brazements.

48205 (CONF-840978—3) Corrosion of ceramics in heat exchanger applications. Easler, T.E.; Poeppel, R.B. (Argonne National Lab., IL (USA)). Aug 1984. Contract W-31-109-ENG-38. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84017459.

From International symposium on high temperature corrosion in energy systems; Detroit, MI, USA (17 Sep 1984).

The corrosion behavior of several structural ceramic materials was evaluated under laboratory controlled conditions as a step in assessing their compatibility with a coal gasification environment. Application of these materials in heat recovery systems is of interest. Several variables including material composition, exposure temperature, and the presence or absence of a coal slag coating were investigated. The results indicate that the silicon carbide ceramic materials included in this study perform very well in the absence of fused coal slag. The presence of molten slag at high temperature, however, resulted in some material degradation via surface reaction and penetration. 15 references, 5 figures, 4 tables.

48206 (CONF-8409130—3) Amorphization of ceramics by ion beams. McHargue, C.J.; Farlow, G.C.; White, C.W.; Williams, J.M.; Appleton, B.R.; Naramoto, H. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85000936.

From International conference on surface modification of metals by ion beams; Heidelberg, F.R. Germany (17 Sep 1984).

The influence of the implantation parameters fluence, substrate temperature, and chemical species on the formation of amorphous phases in Al_2O_3 and α-SiC was studied. At 300°K, fluences in excess of 10^{17} ions.cm^{-2} were generally required to amorphize Al_2O_3; however, implantation of zirconium formed the amorphous phase at a fluence of 4 x 10^{16} Zr.cm^{-2}. At 77°K, the threshold fluence was lowered to about 2 x 10^{15} Cr.cm^{-2}. Single crystals of α-SiC were amorphized at 300°K by a fluence of 2 x 10^{14} Cr.cm^{-2} or 1 x 10^{15} N.cm^{-2}. Implantation at 1023°K did not produce the amorphous phase in SiC. The micro-indentation hardness of the amorphous material was about 60% of that of the crystalline counterpart.

48207 (DOE/ER/05866—1) Structure of neutron damage in ionic refractory oxides. Final report. Crawford, J.H. Jr. (North Carolina Univ., Chapel Hill (USA)). 1984. Contract AS05-78ER05866. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85000052.

Most attention was given to lattice defects created by fast neutron bombardment in α.Al_2O_3 but other oxides such as MgO and $MgAl_2O_4$ also received much attention. In one instance a trasition metal oxide, namely, NiO, was investigated relative to bound polaron motion. The primary experimental tool was optical absorption spectra from 185 to 1000 nm. Emission spectra, thermally stimulated luminescence, themally stimulated conductivity, ESR, and thermally stimulated depolarization were also used.

48208 (DOE/ER/45046—T1) Study of charge transport in the thermoelectret state of some ceramics and glasses. Progress report, July 1, 1983-May 1984. Puri, O.P. 1984. Contract AS05-83ER45046. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85001763.

Goal is to investigate the mechanism and decay of electrets in nonpolar inorganic polycrystalline and amorphous dielectrics. Experiments were performed to develop electrets, measure charge, and collect data on these decays. Zirconia was used. (DLC)

48209 (DOE/ET/10357—T1) Ceramic technology readiness program. Eleventh monthly technical progress report, July 31, 1978-August 27, 1978. (AiResearch Mfg. Co., Phoenix, AZ (USA)). 10 Sep 1978. Contract AC01-77ET10357. 24p. (FE—2664-11). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84017364.

Objective is to provide convincing evidence of the ability of ceramic components to survive for lifetimes adequate for utility applications in an environment of high-temperature combustion products from coal-derived fuels and to develop and demonstrate technology to advanced gas turbines operating on coal-derived fuels in utility base load and intermediate load service.

48210 (DOE/OR/21400—T44) Refractories in slagging gasifers. Seventh quarterly progress report, April 1-June 30, 1982. Muan, A. (Pennsylvania State Univ., University Park (USA). Coll. of Earth and Mineral Sciences). Jul 1982. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84017618.

Refractories used in coal gasifiers at high temperatures are subject to severe corrosion by coal-ash slags. Equilibrium relations are being determined for a number of oxide combination of simplified coal-ash slags, mainly in the system CaO-FeO-Al_2O_3-SiO_2, with refractory oxides (MgO, Al_2O_3,Cr_2O_3) as additional components. Special attention is directed toward chromium oxide-containing phases (mainly Al_2O_3-Cr_2O_3 solid solutions and various spinel phases involing Cr_2O_3 as a component), and toward determining the role of iron oxide in reactions involving such phases with coal-ash slags. The equilibrium relations in systems involving Fe and Cr are dependent on the oxygen potential. The present studies, therefore, are carried out under carefully controlled atmospheric conditions. Most of the runs are made under the relatively reducing conditions of CO_2-H_2 atmosphere of ratio $CO_2/H_2=10/1$, while additional runs are being made in CO_2-H_2 atmospheres of other CO_2/H_2 ratios, in pure CO_2, in O_2-N_2 atmospheres, in air, or in Ar atmosphere in the presence of metallic Cr.

48211 **(PB—84-178904) Purification of zirconyl sulfate by solvent extraction. Report of investigations/1984.** MacDonald, D.J.; Henry, H.G.; Bauer, D.J. (Bureau of Mines, Reno, NV (USA). Reno Research Center). Feb 1984. 37p. NTIS, PC A03/MF A01.

The Bureau of Mines has conducted bench-scale investigations leading to the design of an integrated process for producing reactor-grade zirconium oxide (ZrO2) from zircon sand, which avoids the air pollution, water pollution, fire hazard, and odor problems associated with the hexone-thiocyanate process. The integrated process consists of three steps: production of crude zirconyl sulfate solution, solvent extraction, and production of ZrO2 from strip liquor. This report describes the solvent extraction step. Multistage, countercurrent liquid-liquid extraction with a tertiary amine in kerosine was used to separate zirconium from a dilute H2SO4 solution containing hafnium and other impurities. These steps were performed simultaneously in steady-state, bench-scale experiments. Zirconium recovery of up to 93 pct was achieved. Results of an economic evaluation are included.

48212 **Study of the Kondo effect and intrinsic electrical conduction in titanium diboride.** Williams, R.K.; Becher, P.F.; Finch, C.B. (Metals and Ceramics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Journal of Applied Physics;* **56**: No. 8, 2295-2302(15 Oct 1984). Contract AC05-84OR21400.

Electrical resistivity data for seven dense polycrystalline TiB_2 samples are reported. The data, which extend from 4.2 to 300 K, all show resistivity minima in the 34 — 47 K range and this is attributed to the Kondo effect. Although the residual resistivity values varied by only a factor of about 2, the strength of the Kondo effect changed by a factor of 15. These differences are related to the effects of processing variables. The ideal resistivity of TiB_2 was calculated from the measurements and was found to vary about as T^5 at low temperatures. These values can be adequately described by the Bloch—Grueneisen equation, and the characteristic temperature obtained from resistivity, 720 K, is in reasonably good agreement with the Debye temperature from specific heat measurements. A comparison of the electronic scattering part of the Bloch—Grueneisen constant shows that TiB_2 is a somewhat better conductor than Ti and the electronic band structures of ZrB_2 and Zr help to explain this difference.

48213 **Optical properties of CaO crystals containing hydrogen.** Gonzalez, R.; Summers, G.P.; Chen, Y. (Departmento Fisica del Estado Solido, Universidad Complutense de Madrid, Madrid, Spain). *Physical Review [Section] B: Condensed Matter;* **30**: No. 4, 2112-2116(15 Aug 1984).

Optical-absorption measurements show that substitutional H^- ions (that is, protons on anion sites each with two electrons) are thermally more stable than anion vacancies when thermochemically reduced CaO samples are annealed in a reducing atmosphere. Electron irradiation decreases the concentration of H^- ions and increases the concentration of oxygen vacancies with a cross section much larger than for elastic collision damage. The room-temperature lifetime of the 2.1-eV F-center luminescence decreases as the concentration ratio of F centers to H^- ions increases.

48214 **Analytical and structural analysis of the lanthanum-deficient lanthanum hexaboride.** McKelvy, M.J.; Eyring, L.; Storms, E.K. (Arizona State Univ., Tempe). *Journal of Physical Chemistry;* **88**: No. 9, 1785-1790(26 Apr 1984).

The blue lanthanum boride LaB/sub 6+δ/ previously reported as LaB_9, was investigated in arc-melted samples of LaB_6 bulk stoichiometry. The samples were structurally analyzed by high-resolution transmission electron microscopy including comparative computer imaging and analytically studied by using backscattered electron imaging, quantitative characteristic x-ray analysis, nuclear magnetic resonance, and other techniques. The blue boride observed has a composition of LaB/sub 6.13 +- 0.03/ due to random La vacancies in the LaB_6 structure and is interpreted as belonging to the nonstoichiometric LaB_6 phase region. The color change from purple to blue occurs for decreasing lanthanum content roughly at a composition $LaB_{6.07}$. A modification of the La-B phase diagram is proposed.

48215 **μiSR study of some magnetic superconductors.** Huang, C.Y.; Fisk, Z. (Los Alamos National Lab., NM (USA)); Ansaldo, E.J.; Brewer, J.H.; Harshman, D.R. (British Columbia Univ., Vancouver (Canada). TRIUMF Facility); Crowe, K.M.; Rosenblum, S.S.; Clawson, C.W. (Lawrence Berkeley Lab., CA (USA)); Lambert, S.; Torikachili, M.S. *Hyperfine Interactions;* **18**: No. 1-4, 509-514(Jan 1984). (CONF-830455—).

From Yamada conference on muon spin rotation and associated problems; Shimoda, Japan (18 Apr 1983).

The relaxation of the μ^+SR signal has been investigated for the three compounds YRh_4B_4, $ErRh_4B_4$ and $SmRh_4B_4$. In the nonmagnetic superconducting (Tsub(c) approx. 11 K) YRh_4B_4, the data display a Kubo-Toyabe (gaussian) shape for zero (transverse) magnetic fields. $ErRh_4B_4$ (superconducting below 8.7 K and ferromagnetic below 1 K) shows a dominant signal with very slow relaxation. In contrast $SmRh_4B_4$ (superconducting below 2.7 K and antiferromagnetic-superconducting below 0.87 K) shows a change in relaxation from gaussian above approx. 60 K to exponential between 1 K and 4 K to two exponential signals (fast and slow) below Tsub(N) = 0.9 K. In the region $0.9 K < T < 4.5 K$, the relaxation time and the asymmetry both increase with T.

48216 **Measurement of surface machining damage in ceramics.** Khuri-Yakub, B.T.; Evans, A.G.; Kino, G.S.; Marshall, D.B.; Shui, Y. (Ginzton Lab., Stanford Univ., Stanford, CA). pp 229-237 of Review of progress in quantitative nondestructive evaluation, Vol. 3A. Thompson, D.O.; Chimenti, D.E. New York, NY, USA; Plenum Press (1984). (CONF-830811—).

From Conference on quantitative NDE; Santa Cruz, CA, USA (7 Aug 1983).

This chapter shows how measuring the reflection coefficient of subsurface cracks versus frequency makes it possible to make accurate prediction of crack sizes and failure stress, which will enable the determination of the extent of machining damage in brittle materials. The machining damage is simulated by machining a Knoop indentor into the surface of a sample, then dragging the indentor to generate a subsurface crack of the required lateral extent. It is determined that the long slot-like cracks are closed at the crack mouth due to residual stress, and when the samples are stressed to fracture, a single halfpenny shaped crack grows from the precrack and leads to failure. The predicted fracture stress is calculated using the fracture mechanics model and it is compared to the actual fracture stress. It is determined that the reduction in error in fracture stress prediction over crack sizing is due to the square root dependence of the fracture stress on crack size.

48217 **(LA-tr—68-24) Electrical conductivity of tantalum carbides.** Gel'd, P.V.; Dubrovskaia, L.B.; Matveenko, I.I. Translated from *Trudy Instituta Khimii, Akademiya Nauk SSSR, Ural'skii Filial ;* No. 9, 17-21(1966). Contract W-7405-ENG-36. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84017373. DE84017373

The electrical resistivity of TaC/sub x/ was measured for x = 0.21 to 0.98 at 80 to 1500°K. There is a maximum at x = 0.73. (DLC)

3604 Polymers And Plastics

48218 **(AD-A—141674/2) Synthesis and evaluation of improved electron-beam and x-ray lithographic resist polymers. Final report 1 July 1979-31 December 1981.** Pittman, C.U. Jr. (Alabama Univ., University (USA)). May 1984. 9p. NTIS, PC A02/MF A01.

It was the goal of this research to investigate the relationship between the chemical structure of polymers and the properties which would result in a new generation of lithographic resists for electron-beam and X-ray lithography. Thus, the synthesis of a variety of vinyl homopolymers, copolymers and terpolymers was undertaken where quaternary centers were present along the polymer backbone.

48219 (CONF-840805—22) **Fungal synthesis of exopolysaccharides.** Griffith, W.L.; Compere, A.L. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84017595.

From 188. meeting of the American Chemical Society; Philadelphia, PA, USA (26 Aug 1984).

Several fungal polysaccharides are currently used as thickening agents for materials ranging from enhanced oil recovery brines and drilling muds to foods. These polymers are generally produced during exponential fungal growth and appear to be normal cell wall constituents. As thickeners, they tend to be comparable to xanthan, and exhibit a similar non-Newtonian response to shear. Polymers which do not have carboxyl or amine group substituents tend to be less sensitive to high concentrations of multivalent ions, a problem in many brine and food systems. The fungal polymers have related fermentations and separations. They compete for a similar product market. Where families of polymers have a common backdone, they are susceptible to hydrolysis by the same enzymes.

48220 **Laser-induced interior cracks for ultrasonic NDE.** Hsu, D.K.; Li, Y. (Colorado State Univ., Fort Collins, CO). pp 263-267 of Review of progress in quantitative nondestructive evaluation, Vol. 3A. Thompson, D.O.; Chimenti, D.E. New York, NY, USA; Plenum Press (1984). (CONF-830811—).

From Conference on quantitative NDE; Santa Cruz, CA, USA (7 Aug 1983).

This chapter describes a technique for inducing interior fracture cracks in transparent plastic resin with focused laser energy. An infrared laser beam from a pulsed YAG laser at a wavelength of 1.06 μm and approximately 1 cm in diameter was focused with a lens into the interior of a resin block made from commercial casting resin. The advantages of the examined technique are that it is easy to implement, the induced damages are usually flat circular cracks which closely approximate the "penny-shaped crack," and the method provides a variety of crack size and orientation for ultrasonic sizing experiments and the results can be compared with direct optical microscopic measurements. Topics considered include the properties of laser-induced cracks and a description of the fabricated specimens. It is determined that the damage threshold power for casting resin is lower than that for polymethyl methacrylate (PMMA) by several orders of magnitude.

3606 Other Materials

REFER ALSO TO CITATION(S) 36060047489, 47489, 47491, 47596, 47598, 48174, 48196, 48327, 48498, 48600, 48650

48221 (AD-A—141447/3) **Magnetic behavior of pressure quenched cadmium sulfide containing chlorine. Final report.** Cote, P.J.; Homan, C.G.; Moffatt, W.C.; Block, S.; Piermarini, G.P. Nov 1983. 28p. (ARLCB-TR—83044). NTIS, PC A03/MF A01.

Presented at AIRAPT International High Pressure Conference (9th), Albany, NY, 26 July 1983.

Pressure quenched cadmium sulfide (CdS) containing chlorine (Cl) has been shown previously to exhibit both very large diamagnetism and paramagnetism. The diamagnetism observed at 77K approached Meissner proportion and suggested superconducting like behavior in this material. The effect is known to depend sensitively on the Cl content of the starting material. This report describes the results of a survey of the magnetic behavior of pressure quenched samples prepared from CdS systematically doped with increasing amounts of Cl. The Cl doped material was prepared in a variety of ways: from mixtures of CdS and CdCl2, by precipitation from aqueous solution, and by acid doping. The differently doped starting materials were analyzed for Cl and other impurities before being pressure quenched. The magnetic susceptibilities were subsequently measured. The results of the survey indicate that the concentration of Cl required to produce specimens with anomalously large magnetism is 0.75 + or - 0.10 weight percent. The technique for the preparation of such material is described.

48222 (AD-A—141563/7) **Wind tunnel material test to quantify space shuttle external tank insulation requirements. Final report 26-28 July 1983.** Hartman, A.S. (Arnold Engineering Development Center, Arnold Air Force Station, TN (USA)). Sep 1983. 37p. NTIS, PC A03/MF A01.

Prepared in cooperation with Calspan Field Services, Inc., Arnold AFS, TN.

The objective of this test was to determine the response of the thermal protection material used in the press line bracket/cable tray region of the Space Shuttle External Tank (ET) to an aerothermal environment. Foam insulation specimens were mounted on a concave plate which was injected to the edge of the wind tunnel nozzle. This allowed the nozzle boundary layer to flow onto the specimen plate. Thus, the turbulent boundary layer approaching the specimen region was significantly thicker than could be produced by other more standard test methods. Data from this test will be used to evaluate a possible reduction in weight of the Space Shuttle External Tank by reducing the amount of insulative material or replacing it with a lighter material.

48223 (AD-A—141597/5) **Dynamical properties of disordered systems. Final report.** Orbach, R.L.; Kennel, C.; Cinderella, A. (California Univ., Los Angeles (USA). Dept. of Physics). 21 May 1984. 36p. NTIS, PC A03/MF A01.

This final report covers the most recent period of the Office of Navy Research Contract titled DYNAMIC PROPERTIES OF DISORDERED SYSTEMS. During this period, research has been completed on a variety of research problems contained in this ONR Research Proposal. The principal areas of research can be summarized under the following categories: 1) The fractal interpretation of amorphous structures; 2) Non-linear conductivity of low dimensional materials; 3) The effect of anodization on the superconducting transition temperature; 4) The time dependence of the remanent magnetization of spin glasses; and 5) The experimental opportunities for physics at high magnetic fields.

48224 (AD-A—141809/4) **Chemical bonding, interdiffusion and electronic structure at Inp, GaAs, and Si-metal interfaces. Interim summary report.** Brillson, L.J. (Xerox Corp., Webster, NY (USA). Webster Research Center). 15 Jan 1984. 200p. NTIS, PC A09/MF A01.

Over the past two years, we have carried out an experimental program to investigate the interface electronic states and its relation to the chemical structure formed at InP, GaAs, and Si-metal interfaces as a result of interfaces chemical reaction and diffusion. We have used soft x-ray photoemission spectroscopy to characterize interfacial bonding and diffusion on an atomic scale. We have used surface photovoltage spectroscopy to identify interface electronic states within the semiconductor band gap. We have also used Auger electron spectroscopy coupled with ion sputtering to profile the interface chemical structure after the Schottky barrier is formed and have identified spatial changes in stoichiometry normal to the interface plane which are dependent on chemical bond strength between metal and semiconductor. These measurements provide new, more detailed relationships between the surface and interface chemical structure on a microscopic scale and the Schottky barrier formation. We have used a number of complementary experimental techniques to probe the electronic structure of semiconductor surfaces and interfaces and its relation to the chemical nature (i.e., new atomic bonding, atomic rearrangement, added chemical species) of these surfaces and interfaces. Our work has concentrated primarily on InP surfaces and interfaces since it exhibits Fermi level movements over a significant part of the band gap and Schottky barriers which are significantly different for junctions with different metals.

48225 (AD-A—141869/8) **Zinc selenide photoelectrodes. Efficient radiative recombination in a stable photoelectrochemical cell. Technical report.** Smiley, P.M.; Biagioni, R.N.; Ellis, A.B. (Wisconsin Univ., Madison (USA). Dept. of Chemistry). 25 May 1984. 30p. NTIS, PC A03/MF A01.

Photoluminescence (PL) and electroluminescence (EL) from single-crystal, n-type, A1-doped ZnSe (ZnSe:A1) electrodes have been studied. These samples exhibit both edge emission (lambda(max) approx. 460 nm) and subband gap emission when excited at several ultraband gap wavelengths. The latter PL band is particularly intense, with a measured radiative quantum yield of approx. 0.1 to 0.01; the transition seems at least partially self-activated (SA) in origin, based on previously reported PL data. Excited-state communication involving the two emissive states is inferred from time-resolved PL measurements. Stable photoelectrochemical cells (PEC's) can be constructed from n-ZnSe:A1 electrodes and aqueous diselenide or ditelluride electrolytes. Applied potential quenches both of the photoanodes' PL bands roughly in parallel. The extent of PL quenching is consistent with a dead-layer model previously used to describe quenching in Au-ZnSe Schottky diodes. When used as a dark cathode in aqueous, alkaline peroxydisulfate eletrolyte, EL from ZnSe:A1 electrodes is observed.

48226 (AECL—7805) **Thermal properties of clay-based buffer materials for a nuclear fuel waste disposal vault.** Radhakrishna, H.S. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Jun 1984. 61p. AECL, Scientific Document Office, Chalk River, Ontario, Canada $4.00. File Number TI84901835.

Work performed under Canada/US Waste Management Information Exchange Agreement.

The thermal properties of three types of bentonite clay, one illite-rich shale and one kaolin mixed with crushed granite were investigated. Thermal conductivity measurements were made over a range of mix proportions, moisture content, density and ambient temperature using the transient heat-probe method. The effects of thermal drying in the buffer zone prior to water uptake were investigated by means of laboratory-scale heater experiments. Illite-rich shale (Sealbond) and kaolin exhibited better compactability and thermal conductivity than the bentonite clays. The thermal conductivity of all types of clay buffers showed a high degree of moisture dependency and relatively no effect due to elevated temperature under high fluid pressure conditions. Bentonite buffers compacted to a dry density of 1200 to 1400 kg/m^3 showed extensive cracking due to differential shrinkage. Addition of crushed granite, and/or compaction to a higher density, reduced the thermal cracking of the buffer material. 11 references, 31 figures, 9 tables.

48227 (BNL—35110) **Neutron diffraction studies of the hydrogen bonding and water molecules in zeolites.** Artioli, G.; Smith, J.V.; Kvick, A.; Pluth, J.J.; Stahl, K. (Chicago Univ., IL (USA). Dept. of Geophysical Sciences; Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 7p. (CONF-8409135—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84016431.

From International symposium on zeolites; Portoroz, Yugoslavia (3 Sep 1984).

Neutron diffraction studies have been completed at different temperatures for all of the fibrous zeolites (natrolite, scolecite, edingtonite, thomsonite) and completed or in progress for several other zeolites with ordered or disordered frameworks (brewsterite, bikitaite, heulandite, yugawaralite). The evaluation of the data collected to date reveals the complexity of the interaction between cations, water molecules and framework atoms. The role of the water molecules is twofold: to complete the coordination of the cations in the cavities and to minimize the electrostatic repulsion between the framework oxygens. The hydrogen atom arrangement seems to be mainly influenced by the cation-hydrogen repulsion. A secondary effect on the hydrogen bonding system is played by the Si, Al distribution in the framework, that is the charge distribution around the acceptor oxygen atoms. The charge saturation of the framework oxygen atoms, the distance between pairs of available hydrogen bond acceptors and the flexibility of the water molecules determine the hydrogen bond geometry. The hydrogen bond lengths in zeolites are usually long in comparison with the range found in other crystalline hydrates.

48228 (CONF-840145—4) **Ionic and molecular transport in beta- and beta''-alumina.** Bates, J.B. (Oak Ridge National Lab., TN (USA)). Mar 1984. Contract AC05-84OR21400. 19p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85000984.

From INDO-US workshop on diffusion in solids; Bombay, India (9 Jan 1984).

Investigations of rapid transport of cations and water molecules in the β- and β''-alumina family of superionic conductors are reviewed. Particular topics that are discussed include the Haven ratio and mixed-ion effects in β-alumina, and the influence of superlattice ordering on ionic transport in β''-alumina.

48229 (CONF-840705—4) **Single crystal silicon as a low-temperature structural material.** Roach, P.R. (Argonne National Lab., IL (USA)). Jul 1984. Contract W-31-109-ENG-38. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84017469.

From 10. international conference on cryogenic engineering; Espoo, Finland (31 Jul 1984).

In neutron scattering applications, it is frequently desirable to construct a sample container from a material that is strong but has very little neutron absorption or scattering. Single crystal silicon is very good by these criteria but it is difficult to work with because of its brittleness. A technique for gluing silicon has been developed that yields high strength joints at low temperatures and allows very compact designs for sample containers.

48230 (DOE/ER/10934—T2) **Theoretical and experimental study of solid phase miscibility gaps in III/V quaternary alloys. Progress report.** Stringfellow, G.B. (Utah Univ., Salt Lake City (USA)). 1 Nov 1983. Contract AT03-81ER10934. 52p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE84017357.

The research proposed for the third year of the current project was to attempt to grow metastable alloys of GaAs/sub 1-x/ Sb/sub x/ using the nonequilibrium organometallic vapor phase epitaxial growth technique and then study the properties of these metastable alloys including STEM studies and electrical and optical properties characterization. The OMVPE experiments were totally successful. We were indeed able to grow GaAs $_5$Sb$_5$ alloys at 600°C and 630°C right in the middle of the range of solid immiscibility. We were able to use the theoretical thermodynamic framework developed in the first two years of the project to accurately describe the processes occurring during OMVPE, particularly the dramatic effect of V/III ratio on solid composition. The properties appear initially to be quite promising. The surface morphology is excellent and the photoluminescence spectra are typical of III/V alloy semiconductors.

48231 (DOE/ER/12051—T1) **Mechanism of zeolite crystallization and thermochemical properties of some synthetic zeolites. Final report.** Liou, J.G. Sep 1984. Contract AT03-82ER12051. 174p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE85001293.

During the period of 4/1/82 to 9/30/84, the Department of Energy has provided support for laboratory synthesis of zeolites, calorimetric determinations, and thermal analyses on synthetic zeolites. This Final Report to the DOE is written as 6 independent sections. The study is more readily divisible into two parts: the first half deals primarily with synthesis experiments in which zeolites having phillipsite, merlinoite and gismondine structure are precipitated from clear solutions at 80°C in the system K_2O-Na_2O-Al_2O_3-SiO_2-H_2O, and the second half presents a calorimetric study of synthetic merlinoite samples having various Si/Al and Na/(Na + K) ratios. Section 1 describes the zeolite synthesis method, the characterization of the solutions and synthetic zeolites, and investigates the zeolite stability fields. Section 2 describes the results of three sets of precipitation experiments in which the effect of solution composition and structure on the composition, structure, crystallization pathway and growth kinetics of the synthesized zeolites was studied. Low-temperature heat capacities measured by adiabatic calorimetry and derived thermodynamic functions for the synthetic merlinoites are presented in Section 3. Section 4 gives the heats of solution determined by hydrofluoric acid solution calorimetry and enthalpies of formation for these samples. The calculated Gibbs free energies of formation and application of the data to mineral equilibria typical of saline, alkaline lakes are the subjects of Section 5. The final section describes stability relations of 3 common Ca-zeolites laumontite, heulandite and stilbite, and application of their natural parageneses in geothermal areas and low-grade metamorphic terranes.

48232 (INIS-mf—8862) **Neutron scattering of manganite (MnOOH) under the consideration of a new developed method of focusing.** Kasper, F.J. (Technische Univ. Berlin (Germany, F.R.). Fachbereich Physik). 25 Feb 1982. 80p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE84780571.

The magnetic-phase transformations and magnetic structures of MnOOH are studied by neutron scattering between 10 K and 200 K. Inelastic scattering is used to measure the dispersion relations of spin waves and to calculate the exchange interactions. The measuring method and measuring equipment are described in detail.

48233 (INIS-mf—9040, pp 191-192) **Liquid immiscibility in multicomponent borosilicate glasses.** Taylor, P.; Campbell, A.B.; Owen, D.G. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

48234 (MLM-MU—84-69-0002) **Thermal conductivity studies of Fe/KClO$_4$ pellets and some special pellets by the comparative method.** Wang, P.S.; Hall, G.F. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 25 Sep 1984. Contract AC04-76DP00053. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85001879.

Thermal conductivities (λ) of Fe/KClO$_4$ pellets and some other special pellets provided by SNLL were measured at various temperatures by the comparative method with Pyroceram 9606 as reference. An increase in λ value with residence time at higher temperature in Fe/KClO$_4$ reactant pellets has been observed, possibly as a result of slow chemical reaction at these temperatures; λ values were obtained by extrapolation to zero residence time for these samples. Fe/KClO$_4$ result show that the burned pellets are better thermal conductors than unburned ones; high-density pellets have higher λ values than do the low-density ones; and 84/16 pellets are better thermal conductors than 80/20 pellets. All samples showed a slight decrease of λ at higher temperatures. In the SNLL pellets, a drastic drop of thermal conductivities with increasing temperature was observed in $A_{2\ 5}B$ reactant samples. This is believed to be a result of the powder separation within a pellet at higher temperatures. The product pellets show a slight λ increase in the temperature range of ~ 65°C to ~ 239°C.

48235 (PB—84-195239) **Time-to-corrosion of reinforcing steel in concrete slabs. Volume 5. Calcium nitrite admixture or epoxy-coated reinforcing bars as corrosion protection systems. Report for July 1980-December 1982.** Virmani, Y.P.; Clear, K.C.; Pasko, T.J. Jr. (Federal Highway Administration, Washington, DC (USA)). Sep 1983. 80p. (FHWA/RD—83/012). NTIS, PC A05/MF A01.

Color illustrations reproduced in black and white.

Thirty-one relatively large reinforced concrete slabs were fabricated in 1980 using either non-specification epoxy-coated reinforcing steel or calcium nitrite admixture with black (uncoated) steel. Their performance is compared with uncoated steel in concrete without admixtures. The slabs were placed in two lifts: the bottom lift consisted of a bottom mat of reinforcing steel in chloride-free concrete; and a top lift consisting of the top-mat rebars in concrete contaminated with various quantities of sodium chloride. All the electrical connections between the reinforcing mats were made exterior to the slabs so that the corrosion current flow could be monitored. A worst case type of research design was used by specifying poor quality concrete, nonspecification epoxy-coated rebars, and good electrical coupling between the rebar mats. After curing, the slabs were mounted above ground and exposed to the environment of the Washington, D.C. location. They were periodically subjected to additional chloride exposure while being monitored for about 1 year to determine the corrosion rate. Selected slabs were then demolished to confirm the findings of the nondestructive testing.

48236 (SAND—84-0650C) **Effect of hydrostatic pressure on trapping centers in strained-layer superlattice structures.** Barnes, C.E.; Samara, G.A.; Biefeld, R.M.; Osbourn, G.C.; Zipperian, T.E. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1984. Contract AC04-76DP00789. 5p. (CONF-840879—8). NTIS, PC A02/MF A01; GPO Dep. File Number DE85001362.

From 17. international conference on the physics of semiconductors; San Francisco, CA, USA (6 Aug 1984).

This paper reports initial results on the effects of hydrostatic pressure on the emission energies of two prominent deep levels in gamma-irradiated SLS's consisting of alternating layers of GaP and GaAsP grown by MOCVD. As the growth of an SLS affects the lattice constants of the individual components, the application of hydrostatic pressure to a semiconductor can also affect the lattice constant and the bulk electronic properties. This parallel suggests that the properties of the host-SLS may have an effect on the response of the trap to pressure.

48237 (SAND—84-1902C) **Ion-implantation doping of strained-layer superlattices.** Myers, D.R. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 17p. (CONF-841117—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85001903.

From 8. conference on the application of accelerators in research and industry; Denton, TX, USA (12 Nov 1984).

Strained-layer superlattices (SLS's) are a novel class of electronic materials whose bandgap and transport properties can be tailored during growth by the selection of appropriate layer thickness and chemical composition. Localized doping of III-V compound semiconductor SLS's can be achieved by masked ion implantation followed by controlled atmosphere annealing. Electrical activation of the implanted species and survival of the host superlattice can be detected by Raman spectroscopy; these conclusions are reinforced by a variety of complementary measurements. Values for dopant electrical activation and mobilities in the implantation-doped SLS's are consistent with those obtained for similar implants and anneals in the nearest binary compound semiconductors. These results reflect favorably on the stability of strained-layer superlattices and allow exploitation of the unique properties of strained-layer superlattices in novel electronic devices.

48238 **Doping of phosphorus in hydrogenated amorphous silicon by a neutron transmutation doping technique.** Hamanaka, H.; Kuriyama, K.; Yahagi, M.; Satoh, M.; Iwamura, K.; Kim, C.; Kim, Y.; Shiraishi, F.; Tsuji, K.; Minomura, S. (College of Engineering and Research Center of Ion Beam Technology, Hosei University, Koganei, Tokyo 184, Japan). *Applied Physics Letters;* 45: No. 7, 786-788(1 Oct 1984).

Doping of phosphorus in hydrogenated amorphous silicon (a-Si:H) produced by rf glow discharge has been achieved by a neutron transmutation doping technique. Electrical and electron spin resonance measurements showed that the neutron irradiation damages have been recovered by the thermal annealing near the growth temperature of a-Si:H films. After thermal annealing at 220 °C, the activation energies of 0.57 and 0.50 eV were obtained for transmuted phosphorus concentrations of 3.1×10^{12} and 1.6×10^{13}/cm^3, corresponding to neutron doses of 1.8×10^{16} and 9.0×10^{16} n/cm^2, respectively.

48239 **Silica at ultrahigh temperature and expanded volume.** Holmes, N.C.; Radousky, H.B.; Moss, M.J.; Nellis, W.J.; Henning, S. (University of California, Lawrence Livermore National Laboratory, Livermore, California 94550). *Applied Physics Letters;* 45: No. 6, 626-628(15 Sep 1984). Contract W-7405-ENG-48.

Shock compression experiments were performed on samples of 0.13 g/cm^3 density silica aerogel. The aerogel is a transparent, homogeneous, open cell, SiO$_2$, glass structure with a pore size of 10 nm. A shock velocity of 11.4 km/s was measured at 14.6 GPa (146 kbar) and over sevenfold compression of the specimen, which is threefold expanded relative to the density of crystalline α-quartz. A shock temperature of nearly 1 eV was measured at 6.7 GPa. These experiments access a new regime for accurate laboratory measurements on high-temperature, expanded-volume states of glass.

48240 **Metal-insulator transition on the Ge(001) surface.** Kevan, S.D.; Stoffel, N.G. (AT & T Bell Laboratories, Murray Hill, New Jersey 07974). *Physical Review Letters;* **53**: No. 7, 702-705(13 Aug 1984). Contract AC02-76CH00016.

High-resolution angle-resolved photoemission studies of the Ge(001) surface are reported which clearly indicate the existence of a metallic surface state whose emission is observed over a narrow range of parallel momenta near the center of the surface Brillouin zone. The state slowly disappears as the temperature is lowered from room temperature to 77 K. This metal-insulator transition is coincident with a recently predicted and observed transition from a disordered to an ordered c(4 x 2) structure.

48241 **Ag-InP(110) interface: Photoemission studies of interfacial reactions and Schottky-barrier formation.** Babalola, I.A.; Petro, W.G.; Kendelewicz, T.; Lindau, I.; Spicer, W.E. (Stanford Electronics Laboratories, Stanford University, Stanford, California 94305). *Physical Review* [*Section*] *B: Condensed Matter;* **29**: No. 12, 6614-6622(15 Jun 1984).

The effects of interfacial reaction at Ag-InP(110) interfaces have been studied with soft-x-ray photoemission spectroscopy of the core levels and valence band. By systematically increasing the Ag coverages, we have been able to identify two coverage ranges with different stages of physical interactions and interface developments from a detailed study of the In 4d, P 2p, and Ag 3d core levels as well as valence-band structures. At lower Ag coverages [0<CTHETA<1 monolayer (ML)], identified as the "band-bending region," both the In 4d and P 2p levels shift by the same amount with no measurable changes in the core-level shapes for both n and p type, and a continuous and monotonic shift of the Ag 3d core levels toward their metallic positions is observed with increased Ag coverages. At high coverages (1< or =CTHETA<72 ML), identified as the "intermixed region," the presence of P atoms at the topmost layer and evidence of dissociated In were observed from the core-level variations and relative intensity studies at the interface. In both regions, island growth of the overlayer is observed. The surface-Fermi-level (E/sub F/s) pinning position, determined from core-level movements in this region, can be affected by the intermixing of Ag with dissolved InP constituents. Ag interacts with InP in a way that is essentially different in details as compared with other metals, to the extent that the model identifying Ag as a nonreactive metal on InP may need to be modified.

48242 **Polarization dependence of Ge(111)2 x 1 surface-state absorption using photothermal displacement spectroscopy: A test of surface reconstruction models.** Olmstead, M.A.; Amer, N.M. (Applied Physics and Laser Spectroscopy Group, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review* [*Section*] *B: Condensed Matter;* **29**: No. 12, 7048-7050(15 Jun 1984). Contract AC03-76SF00098.

The polarization dependence of surface-state absorption of Ge(111)2 x 1 single-domain surfaces has been directly measured using photothermal displacement spectroscopy. The absorption at 0.5 eV is maximum for incident light polarized perpendicular to the period-doubling direction of the 2 x 1 reconstruction. As the polarization direction is rotated, the absorption follows a $\cos^2\theta$ dependence. This result supports the π-bonded chain model for the surface reconstruction, and is the same as that recently reported for the dangling-bond absorption of Si(111)2 x 1.

48243 **Low frequency double electron muon resonance (DEMUR) in fused quartz.** Estle, T.L.; Warren, M.E. (Rice Univ., Houston, TX (USA). Dept. of Physics); Boekema, C.; Heffner, R.H. (Los Alamos National Lab., NM (USA)). *Hyperfine Interactions;* **18**: No. 1-4, 575-579(Jan 1984). (CONF-830455—).

From Yamada conference on muon spin rotation and associated problems; Shimoda, Japan (18 Apr 1983).

Double electron muon resonance was studied with comparable amplitudes of the static and RF magnetic fields. The experiments were carried out in fused quartz and employed a resonant linearly-polarized RF field and a small static field. For small amplitudes of the RF field a three-line frequency spectrum was obtained consisting of a central line at the RF frequency and two weaker lines of equal amplitude symmetrically positioned about the central line. A symmetrical three line spectrum is predicted for muonium using the rotating wave approximation (RWA). For large RF fields the amplitudes of the three lines were not symmetric and depended on whether positrons were observed parallel or perpendicular to the beam. For very large RF fields the total amplitude of all the lines was less than for lower RF fields. These results do not agree with the theory using the RWA and no satisfactory theory currently exists.

48244 **Ultrasonic studies of strength-related properties of graphite.** Wang, S.; Adler, L. (Ohio State Univ., Columbus, OH). pp 1211-1219 of Review of progress in quantitative nondestructive evaluation, Vol. 3B. Thompson, D.O.; Chimenti, P.E. New York, NY, USA; Plenum Press (1984). (CONF-830811—).

From Conference on quantitative NDE; Santa Cruz, CA, USA (7 Aug 1983).

This chapter investigates nondestructive ultrasonic methods for the evaluation of the fracture parameters of graphite. Fracture strength is calculated from the Griffith-Irwin equation which is the basis of fracture mechanics in graphite. Topics considered include Buch's mechanical model for graphite, multiple scattering theory, the ultrasonic attenuation coefficient, and the ultrasonic velocity. The parameter of Young's modulus/attenuation coefficient is compared to the fracture strength. It is determined that the ultrasonic attenuation coefficient is proportional to the pore size and porosity content, and that the ultrasonic velocity decreases with increasing porosity.

48245 **Positron and electron channeling radiation from germanium.** Park, H.; Swent, R.L.; Kephart, J.O.; Pantell, R.H. (Stanford Univ., CA). *Physics Letters;* **96A**: 45-48(6 Jun 1983). Contract W-7405-ENG-48;W-7405-ENG-26.

Channeling-radiation spectra have been obtained from a germanium crystal with 54.3 MeV positrons and electrons and with 16.9 MeV electrons. Theoretical calculations were performed and are found to agree reasonably well with the experimental results. When the emission spectra for (110) planar channeling in diamond, silicon, and germanium are compared, the corresponding lines for both positrons and electrons are found to be lowest in energy for silicon.

48246 **Second harmonic generation in centro-symmetric semiconductors.** Guidotti, D.; Driscoll, T.A.; Gerritsen, H.J. (Brown Univ., Providence, RI). *Solid State Communications;* **46**: No. 4, 337-340(1983). Contract FG02-79ER10537.

Second harmonic generation is observed in Si and Ge at electron-hole plasma densities of 10^{21} -10^{22}cm^{-3} and found to depend strongly on crystal orientation. A lower crystal symmetry within the absorption volume is consistent with a model in which depletion of covalent bond charge, and subsequent lattice softening, is brought about by laser excitation of a high density of electrons into antibounding states.

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48247 **(DOE/ER/13158—T1) Metal-support interactions: the effect of catalyst preparation on catalytic activity. Progress report, December 1, 1983-November 30, 1984.** Schwarz, J.A. (Syracuse Univ., NY (USA). Dept. of Chemical Engineering and Materials Science). 1984. Contract AC02-84ER13158. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84017425.

Work this past year has been directed towards four major areas: experimental study of the effect of the wet chemical steps involved in the preparation of a known strong-metal support interaction system (SMSI), namely Pt/TiO_2; experimental study of the effect of added acids and bases on the formation of a prototype bimetallic catalyst system, namely, $Pt/Ir/Al_2O_3$; theoretical study of the limitations of treating a differential catalyst bed operating under transient conditions as an ideal continuous stirred-tank reactor; and preparation of 30 Ni/Al_2O_3 catalysts. During preparation the weight loading and pH were varied systematically and thus nickel speciation as Ni^{++} or $Ni(OH)^+$ in the electrolyte was controlled.

4001 Analytical And Separations Chemistry

REFER ALSO TO CITATION(S) 40010047314, 47316, 47316, 47316, 47323, 47324, 47327, 48174, 48211

48248 (AD-A—142213/8) **Measurement of soft x-ray absorption spectra with a fluorescent ion chamber detector. Technical report.** Lytle, F.W.; Greegor, R.B.; Sandstrom, D.R.; Marques, E.C.; Wong, J. (Washington State Univ., Pullman (USA). Dept. of Physics). 23 May 1984. 26p. (TR—4). NTIS, PC A03/MF A01.

Absorption spectra at the K-edges of S, C1, Ar, and K have been measured in fluorescence mode on the hard x-ray beam lines at SSRL using an ion chamber detector collecting 20% of 2 pi. In spite of diminished x-ray flux and fluorescent yield, sufficient sensitivity was obtained to characterize one percent S in coal. On an unfocused wiggler beam line a resolution of 0.5 eV was obtained at the S K-edge.

48249 (DOE/CS/66001—6) **Isothermal separation processes update. Energy Conversion and Utilization Technologies Program.** England, C. Aug 1984. Contract AI01-81CS66001. 48p. (JPL—9950-927). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85000321.

The isothermal processes of membrane separation, supercritical extraction and condensed-phase chromatography were examined using availability analysis, a method which addresses the thermodynamic value of energy as well as its amount. The general approach was to derive equations that identified where energy, expressed in terms of thermodynamic work, is consumed in these processes and how they compare with conventional separation methods. These separation methods are characterized by pure work inputs, chiefly in the form of a pressure drop which supplies the required energy. Equations were derived for the energy requirement in terms of the theories of ideal and regular solutions. This approach is believed to accurately predict the work of separation in terms of the heat of solution and the entropy of mixing. It can form the basis of a convenient calculation method for optimizing membrane and solvent properties for particular applications. Close examination of supercritical extraction found a relatively simple thermodynamic relationship among the thermodynamic properties of the solvent, the entropy of mixing, and the heat of solution. This allows a direct estimate of the work requirements. The actual work, however, is largely due to the requirement to cycle pressure at high levels in this method. Still, the energy requirements are very low, making up for usually high capital costs for equipment. 12 references, 9 figures, 2 tables.

48250 (DOE/ER/60100—4) **Prediction of retention indices of polynuclear aromatic hydrocarbons. Part I. HPLC on nitrogen containing normal phase packing materials.** Karlesky, D.; Warner, I.M.; Ho, C.N.; Kennedy, J.R. 1984. Contract AS05-82ER60100. 29p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85001302.

A new method for predicting retention indices of polynuclear aromatic hydrocarbons in chromatographic separation is presented. In this manuscript, we are concentrating our discussions on HPLC. Part II focuses on gas chromatography (GC). The method is based on trigonal additivity as a means to quantitively assign a value for the structural, and more importantly, electronic properties of a PAH, and to correlate these values with their retention indices on nitrogen-containing bonded phases. Trigonal additivity takes into consideration all of the major electronic interactions in the molecule. Since it has been applied with success for correlating thermodynamic properties of molecules, it should be an appropriate parameter for correlation of retention data in chromatography. Findings are compared using trigonal additivity with that of the well-known molecular connectivity index of Randic, and propose plausible explanations for the observed correlations.

48251 (DOE/ER/60100—5) **Prediction of retention indices of polynuclear aromatic hydrocarbons. Part II. Capillary gas chromatography.** Ho, C.N.; Kennedy, J.R.; Samyajulu, G.R.; Karlesky, D.; Warner, I.M. [1984]. Contract AS05-82ER60100. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85001301.

A trigonal additivity procedure has been examined and found to correlate well with retention indices for polynuclear aromatic hydrocarbons on several gas chromatographic stationary phases. The results of this analysis are compared to those obtained using the better known Randic (Connectivity) index.

48252 (INIS-mf—8855) **Determination of lanthanum and lanthanide elements by means of X-ray fluorescence analysis.** Kuelcue, N. (Frankfurt Univ. (Germany, F.R.). Fachbereich Chemie). 14 Sep 1982. 145p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE84780569.

The quantitative analysis of all lanthanide elements (except Pm) was carried out concurrently using X-ray fluorescence analysis. By choice of suitable preparative methods (thin layer samples prepared by pipetting solutions onto filter paper) and use of an internal standard (Sr) it was possible to obtain linear calibration curves up to high concentrations in the solution (85 g/l) and to suppress disturbances caused by absorption and secondary fluorescence. A correction procedure was developed for reflection superimpositions in the L-spectra of the lanthanide elements which, through selection of the most favourable reflections for analysis, permitted concurrent determination of all 14 elements. Main and secondary constituents can be analysed whereas enrichment is required for trace analysis. Under routine usage the actual limits of detection range from 3 to 17 $\mu g/cm^2$ or alternatively 0.3 to 1.7 mg/ml.

48253 (INIS-mf—8858) **Contributions to the prompt neutron activation analysis of industrially used coals and zinc roasting products.** Dammermann, H. (Hannover Univ. (Germany, F.R.). Fakultaet fuer Mathematik und Naturwissenschaften). 4 Feb 1982. 126p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE84780567.

The construction of an irradiation plant for calibration measurement by means of prompt neutron activation analysis is described. A 5.84 μg and 16.3 μg Cf-252 source serve as neutron sources. Tests have shown an inner centred arrangement to offer the best solution for sources of this strength. The use of the PNAA method for determining sulphur, iron and chloride content in brown coal was tested and calibration curves drawn. The sulphur content of the coal briquettes tested was found to be 0.27% S, the iron content amounting to 0.21% Fe and chloride to 0.06%. These values correlate closely with values obtained from wet chemical industrial analysis.

48254 (INIS-mf—9040, pp 193-194) **Determination of ^{129}I in fuel leaching solutions by neutron activation analysis.** Burns, K.I.; Moore, C.J. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment); Ashbourne, E.M. (McMaster Univ., Hamilton, Ontario (Canada). Dept. of Chemistry). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

Published in summary form only.

48255 (INIS-mf—9065, pp 102) **Comparative depth profiling by RBS and AES of ion implanted Al, Ni and their oxides.** Sood, D.K.; Paterson, P.J.K. (Royal Melbourne Inst. of Tech. (Australia)). Nov 1983. NTIS (US Sales Only), PC A10/MF A01. File Number TI84780622. (CONF-8311183—).

From 3. Australian conference on nuclear techniques of analysis; Lucas Heights, Australia (1 Nov 1983).

48256 (INIS-mf—9065, pp 107) **Results of an examination of 31 Hellenistic silver coins using PIXE.** Buckley, J.A. (Sydney Univ. (Australia)). Nov 1983. NTIS (US Sales Only), PC A10/MF A01. File Number TI84780622. (CONF-8311183—).

From 3. Australian conference on nuclear techniques of analysis; Lucas Heights, Australia (1 Nov 1983).

48257 (INIS-mf—9065, pp 122-123) **Study of radioactive disequilibrium in sediments.** Smith, B.W.; Prescott, J.R.; Hutton, J.T.; Jensen, H.E.; Robertson, G.B.; Menzies, N.C.; Akber, R.A. (Adelaide Univ. (Australia). Dept. of Physics). Nov 1983. NTIS (US Sales Only), PC A10/MF A01. File Number TI84780622. (CONF-8311183—).

From 3. Australian conference on nuclear techniques of analysis; Lucas Heights, Australia (1 Nov 1983).

Examples are reported of a study of radioactive disequilibrium in sediments of interest in archaeological and geological contexts. A variety of tests are applied to identify disequilibrium in a marine sediment and a sand dune overlain with lava. A tile from a villa at Pompeii shows radioactive equilibrium.

48258 (INIS-mf—9065, pp 124-126) **Measurement of calcium carbonate in limestone using a neutron technique.** Jensen, H.E. (Australian Mineral Development Labs., Thebarton); Holmes, R.J. (Commonwealth Scientific and Industrial Research Organization, Lucas Heights (Australia). Div. of Mineral Physics). Nov 1983. NTIS (US Sales Only), PC A10/MF A01. File Number TI84780622. (CONF-8311183—).

From 3. Australian conference on nuclear techniques of analysis; Lucas Heights, Australia (1 Nov 1983).

A thermal neutron irradiation technique using a Cf-252 neutron source has been applied to the determination of calcium in limestone samples of about 30kg. The determination is based on the use of a NaI(Tl) detector to monitor the characteristic prompt gamma-rays (6.42MeV) emitted following thermal neutron capture in calcium. Simultaneous determination of iron and silicon is also possible by detecting their characteristic prompt gamma-rays. Potential applications of the method include on-line bulk analysis on conveyor belts or in chutes or hoppers, and the static analysis of bulk limestone samples.

48259 (INIS-mf—9065, pp 141-143) **Proton microprobe analysis of early protosolar condensates.** Lucas, M.A.; McKenzie, C.D. (Melbourne Univ., Parkville (Australia). School of Physics); Wark, D.; Hughes, T.C. (Melbourne Univ., Parkville (Australia). Dept. of Geology). Nov 1983. NTIS (US Sales Only), PC A10/MF A01. File Number TI84780622. (CONF-8311183—).

From 3. Australian conference on nuclear techniques of analysis; Lucas Heights, Australia (1 Nov 1983).

A study of some components of the Leoville and Allende meteorites, both known by their isotope abundances to have formed at the beginning of the protosolar collapse, is reported. Trace element ratios in sulphides and perovskites were investigated in order to gain information on the formation of the sulphides and Ca-Al rich inclusion (CAI) shell matrices.

48260 (INIS-mf—9065, pp 144-147) **On-line bulk analysis of sulphur in lead sinter feed.** Cunningham, J.B.; Greenwood-Smith, R. (Mount Isa Mines Ltd. (Australia)); Sowerby, B.D.; Rafter, P.T. (Commonwealth Scientific and Industrial Research Organization, Lucas Heights (Australia). Div. of Mineral Physics). Nov 1983. NTIS (US Sales Only), PC A10/MF A01. File Number TI84780622. (CONF-8311183—).

From 3. Australian conference on nuclear techniques of analysis; Lucas Heights, Australia (1 Nov 1983).

The measurement of prompt γ-rays from neutron inelastic scattering is a promising technique for the bulk analysis of some elements in mineral samples. One potential application of the technique is the on-line determination of the sulphur content of lead sinter to optimise lead sinter machine performance. Typical sinter plant feed contains about 6 to 7 wt% S and about 40 wt% Pb. The analysis of sulphur is based on the measurement of the 2.23 MeV neutron inelastic scatter γ-ray from sulphur in the presence of the more prominent 2.62 MeV inelastic scatter γ-ray from lead. Measurements made on bulk lead sinter samples have shown that neutron inelastic scattering can be used to determine sulphur, lead, zinc and iron in lead sinter feed to within about 0.3, 0.85, 0.15 and 0.45 wt% respectively. Plant tests of a backscatter gauge are planned to commence in late 1983.

48261 (INIS-mf—9065, pp 166-168) **Applications of Mossbauer spectroscopy in the steel industry.** Fysh, S. (Broken Hill Proprietary Co. Ltd., Shortland (Australia). Central Research Labs.). Nov 1983. NTIS (US Sales Only), PC A10/MF A01. File Number TI84780622. (CONF-8311183—).

From 3. Australian conference on nuclear techniques of analysis; Lucas Heights, Australia (1 Nov 1983).

Analyses of iron ores, sinters, blast furnace slags and cast abrasives by Mossbauer spectroscopy are discussed.

48262 (INIS-mf—9065, pp 169-171) **Surface analysis techniques applied to the characterization of oxide scales formed at high temperatures.** Johnston, G.R. (Materials Research Labs., Maribyrnong (Australia)). Nov 1983. NTIS (US Sales Only), PC A10/MF A01. File Number TI84780622. (CONF-8311183—).

From 3. Australian conference on nuclear techniques of analysis; Lucas Heights, Australia (1 Nov 1983).

Rutherford backscattering and scanning Auger microscopy have been used to characterize oxide films on CoCrAlY, CoCrAl and various ion-implanted CoCrAl alloys. The complementary information that is available using these two techniques is illustrated by presenting RBS spectra and SAM elemental depth profiles for both nonimplanted and Y-implanted CoCrAl alloys.

48263 (INIS-mf—9065, pp 172-174) **Rutherford backscattering analysis of nitrogen implants in Australian steels and associated wear properties.** Pollock, J.T.A.; Kenny, M.J. (Commonwealth Scientific and Industrial Research Organization, Lucas Heights (Australia). Div. of Chemical Physics). Nov 1983. NTIS (US Sales Only), PC A10/MF A01. File Number TI84780622. (CONF-8311183—).

From 3. Australian conference on nuclear techniques of analysis; Lucas Heights, Australia (1 Nov 1983).

A number of bright mild and nitriding Australian steel samples have been implanted with nitrogen using incident energies in the range 25 to 65 keV and nominal doses up to 10^{18} ions cm^{-2}. Rutherford backscattering of ^{4}He ions was used to depth/concentration profile the implant distribution. RBS is fast, non-destructive and convenient for this purpose but is generally thought to lack the necessary resolution for profiling lighter atom distributions. However, the data presented suggests that the method is satisfactory for the higher energy, higher dose implants generally employed in studies of wear enhancement.

48264 (INIS-mf—9065, pp 175-177) **Method for the identification of metals by mass spectrometry.** Swinger, D.L. (Commonwealth Scientific and Industrial Research Organization, Clayton (Australia). Div. of Chemical Physics). Nov 1983. NTIS (US Sales Only), PC A10/MF A01. File Number TI84780622. (CONF-8311183—).

From 3. Australian conference on nuclear techniques of analysis; Lucas Heights, Australia (1 Nov 1983).

Metallic foils are subjected to ionic impact and ions are formed from the metal by electron impact or Penning ionization of sputtered atoms and by secondary ion emission from the cathode surface. Ionic energy analysis is followed by ionic mass analysis.

48265 (INIS-mf—9065, pp 178) **XPS and SIMS analysis of the surface of Synroc; structure and leaching mechanisms.** Myhra, S.; Smart, R.St.C. (Griffith Univ., Brisbane (Australia). School of Science). Nov 1983. NTIS (US Sales Only), PC A10/MF A01. File Number TI84780622. (CONF-8311183—).

From 3. Australian conference on nuclear techniques of analysis; Lucas Heights, Australia (1 Nov 1983).

X-ray photoelectron spectroscopy detected all elemental species of the major phases in Synroc C as well as some important high level waste species. Abundances and chemical states of the elements after leaching of Synroc were investigated. SIMS was used to study the incorporation of Cs in Synroc C.

48266 (INIS-mf—9065, pp 129-132) **Nuclear techniques of analysis in the Australian mineral industry.** Sowerby, B.D. (Commonwealth Scientific and Industrial Research Organization, Lucas Heights (Australia). Div. of Mineral Physics). Nov 1983. NTIS (US Sales Only), PC A10/MF A01. File Number TI84780622. (CONF-8311183—).

From 3. Australian conference on nuclear techniques of analysis; Lucas Heights, Australia (1 Nov 1983).

Nuclear techniques in the on-line and bulk analysis of metalliferous ores and coal are reviewed. Applications to borehole logging, slurry analysis, bulk sample analysis and on-line conveyor belt analysis are included. Techniques discussed include gamma-ray scattering and absorption; neutron activation, neutron capture and neutron inelastic scatter; and X-ray fluorescence and absorption. Emphasis is placed on those techniques which have been used in the Australian mineral industry and on the research and development required to carry them from research to industrial use.

48267 (INIS-mf—9065, pp 133-136) **Determination of solids weight fraction of coal in slurries using neutron and γ-ray transmission techniques.** Gravitis, V.L.; Watt, J.S.; Zastawny, H. (Commonwealth Scientific and Industrial Research Organization, Lucas Heights (Australia). Div. of Mineral Physics). Nov 1983. NTIS (US Sales Only), PC A10/MF A01. File Number TI84780622. (CONF-8311183—).

From 3. Australian conference on nuclear techniques of analysis; Lucas Heights, Australia (1 Nov 1983).

The solids weight fraction of coal in aerated coal slurries can be determined by a technique based on measuring the hydrogen per unit weight in the slurry. A neutron probe determines hydrogen per unit volume based on moderation of fast neutrons from an ^{241}Am/Be neutron source. A γ-ray transmission probe determines density and mean atomic number of the slurry by measuring transmission of 356 KeV and 60 KeV γ-rays. With these two probes immersed in a 200 L drum containing coal slurries, their combined outputs determined solids weight fraction to +-1.3 wt% solids over a range of 0-36 wt% solids and aeration 0-3% by volume.

48268 (INIS-mf—9065, pp 137-139) **On-line and bulk analysis of iron ore and bauxite.** Holmes, R.J.; Roczniok, A.F. Nov 1983. NTIS (US Sales Only), PC A10/MF A01. File Number TI84780622. (CONF-8311183—).

From 3. Australian conference on nuclear techniques of analysis; Lucas Heights, Australia (1 Nov 1983).

A number of analysis techniques based on neutron and gamma radiation have been developed for the mining industry. Current projects include the measurement of annihilation radiation arising from pair production for the on-line determination of the iron content of iron ores, and the construction of a demonstration bauxite analyser based on fast-neutron activation analysis for the simultaneous determination of aluminium and silicon content.

48269 (INIS-SU—247, pp 239-242) **Using 3.05 MeV resonance for determination of oxygen impurities.** Burkova, I.E.; Polyanskij, V.N.; Yatis, A.A. 1983. (In Russian). NTIS (US Sales Only), PC A11/MF A01. File Number TI84780555. (CONF-8205270—).

From 12. All-Union conference on physics of interaction between charged particles and crystals; Moscow, USSR (25 May 1982).

The method of determining oxygen impurities behind thin films using the isolated resonance in the $^{16}O(\alpha, \alpha)^{16}O$ reaction at E=3.048 MeV with the width GITA approximately 20 keV, is considered. Cross section in resonance is σΞsub(R) = 0.95 b and it increases the cross section of Rutherford scattering by the factor of 25. The conclusion is made on the possibility of using 3.048 MeV resonance when investigating Me-Si film structures.

48270 **(MLM-MU—50-67-0008) Monthly progress abstracts of general research, liquid waste disposal research, and biological research for July, 1950.** (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 10 Aug 1950. Contract AC04-76DP00053. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE84016687.

The status of research projects in the following divisions is given: research and development; operations; and biological research.

48271 **(ORNL/TM—9198) Joint United States-Israel desalination project. General technology report.** Reed, S.A. (Oak Ridge National Lab., TN (USA)). Sep 1984. Contract AC05-84OR21400. 53p. NTIS, PC A04/MF A01; GPO Dep. File Number DE84017477.

In mid-1975, the governments of the United States and Israel signed an agreement to jointly design, construct, and operate, during a period of approximately ten years, an advanced prototype of a multieffect low-temperature distillation plant to convert seawater to high-quality freshwater. The distillation plant was to be built at Ashdod, Israel, adjacent to an existing electrical generating plant which would supply both energy (steam and electricity) and Mediterranean Sea feed-water to the distillation plant. The project objectives were essentially achieved, although its scope was reduced. A 5-Mgd Intermediate Module (INTMO - later renamed Multi-effect Low-Temperature [MELT] Plant) was constructed and operated for over a year, coupled to a 50-MW steam turbine. Dual operation, most of the time in a load-following mode, proved to be stable, flexible, and reliable for both the power plant and the desalination plant. Over 2 x 10^6 m^3 of about 50 ppM total-dissolved-solids water was produced from Mediterranean seawater. A calculation, based on an optimized, multiple-unit desalination plant, coupled to a 550-MW, coal-fired, base-loaded power plant, indicates water costs in the order of 55 to 60 cents/m^3. A complete technology package is being furnished to each of the participating governments. The total expenditure for the project, from its inception in 1976 through March 31, 1984, when the operation for data collection and demonstration purposes was completed, was about $31 million.

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REFER ALSO TO CITATION(S) 40020047459, 47578, 48233, 48291, 48292, 48294, 48300

48272 **(CONF-840807—4) Hydrolysis of iodine: equilibria at high temperatures.** Palmer, D.A.; Ramette, R.W.; Mesmer, R.E. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84016713.

From Conference on thermodynamics; Hamilton, Canada (13 Aug 1984).

The hydrolysis (or disproportionation) of molecular iodine to form iodate and iodide ions has been studied by emf measurements over the temperature range, 3.8° to 209.0°C. The interpretation of these results required a knowledge of the formation constant for triiodide ion and the acid dissociation constant of iodic acid, both of which were measured as a function of temperature. The resulting thermodynamic data have been incorporated into a general computer model describing the hydrolysis equilibria of iodine as a function of initial concentration, pH and temperature.

48273 **(CONF-840876—3) Supercell band structure calculations of the two peak photo- and inverse photoemission spectra in Ce and Pr compounds.** Norman, M.R.; Koelling, D.D.; Freeman, A.J. (Argonne National Lab., IL (USA); Northwestern Univ., Evanston, IL (USA). Dept. of Physics). 1984. Contract W-31-109-ENG-38. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84017485.

From International conference on valence fluctuations; Koln, F.R. Germany (27 Aug 1984).

We show that the two peak photoemission and inverse photoemission spectra in Ce and Pr compounds can be determined theoretically using a local density supercell approach with different channels to screen the 4f hole in photoemission and antiscreen the extra 4f electron in inverse photoemission.

48274 **(DOE/ER/04987—T2) Solid state, surface and catalytic properties of oxides. Progress report, September 1983-September 1984.** Kung, H.H. (Northwestern Univ., Evanston, IL (USA). Dept. of Chemical Engineering). Sep 1984. Contract AC02-78ER04987. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85002096.

In the past year, our effort was to: (1) continue to elucidate the relationship between the surface structure of ZnO and the surface chemistry; (2) attempt to understand the relationship between the bulk structure and the selectivity in the oxidation of butene on iron oxide; and (3) explore the use of electrostatic potential argument to explain the formation of new acid sites in a dilute oxide solution. Progress in these areas is described.

48275 **(DOE/ER/06030—5) Kinetic study of radical aromatic hydrocarbon reactions. Progress report, August 1, 1983-June 1, 1984.** (Georgia Inst. of Tech., Atlanta (USA)). Jun 1984. Contract AS05-78ER06030. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85001335.

Efforts have been split in to three research areas: (1) Products in the elementary reactions of Olefinic and aromatic hydrocarbons with simple free radicals: $O(^3P) + C_2H_4$, $O^3(P) + C_6H_6$, OH $(^2\pi) + C_6H_6$, and OH $(^2\pi) + C_2H_4$. (2) Kinetic Studies: the rate coefficients for OH - benzene adduct decomposition is being investigated and the kinetics of $H(^2S) + C_2H_4$ right reversible C_2H_5 system are being measured. (3) Laser Induced Fluorescence Studies: the apparatus needed to carryout LIF on aromatic free radicals has been assembled.

48276 **(DOE/ER/10345—3) Mechanistic studies of carbon monoxide reduction. Progress report.** Geoffroy, G.L. (Pennsylvania State Univ., University Park (USA). Dept. of Chemistry). 1984. Contract AC02-79ER10345. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85001388.

Progress in several areas has been made during the last three years of this research. One of the most significant findings has been the demonstration of CO insertion into μ-CH_2 bonds in Os_3 clusters to yield ketene derivatives. This reaction readily occurs for $Os_3(CO)_{11}(\mu\text{-}CH_2)$, 1, to yield the ketene cluster $Os_3(CO)_{12}(\mu\text{-}CH_2CO)$, 2, which has been crystallographically characterized. Mechanistic studies showed that the incorporated CO came from one of the original cluster CO's and not from exogeneous CO. Also important is the demonstration that the ketene ligand in 2 can be hydrogenated to give CH_3CHO. Other aspects of the derivative chemistry of cluster 1 have been examined. It reacts with SO_2 to give a sulfene-bridged cluster and with halides and axide ion to give clusters of the form $[Os_3(CO)_{10}(\mu\text{-}CH_2)(\mu\text{-}X)]^-$ with X=Cl,Br,I, and NCO. These also insert CO into the metal-methylene bonds to give ketene derivatives, except that the insertions are much faster than the reaction of CO with 1, demonstrating a unique halide promoting effect on the methylene to ketene conversion. Formyl, acyl, carbene, and hydride derivatives of the bis(nitrene) cluster $Fe_3(\mu_3\text{-}NPh)_2(CO)_9$ have also been prepared. A particularly uniquesting reaction here is the coupling of carbene and nitrene ligands observed upon thermolysis of $Fe_3(\mu\text{-}NPh)_2(CO)_8(C(OEt)Ph)$ to yield free imine. A number of binuclear formyl and acyl complexes have been studied, including examples on OsW, FeMn, and IrW frameworks. One of the important conclusions from this work is that μ-acyl ligands are quite unreactive and do not readily undergo transformations characteristic of terminal acyl ligands. During these studies we have also found a unique catalytic system for homogeneous reduction of CO using a combination of $Ru_3(CO)_{12}$ with CuI.

48277 **(DOE/ER/13205—1) Method of vibrational control in the problem of stabilization of chemical reactors. Progress report, March 1-October 31, 1984.** Meerkov, S.M.; Cinar, A. (Illinois Inst. of Tech., Chicago (USA)). Jul 1984. Contract FG02-84ER13205. 95p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85001315.

Results obtained during the first period of the 2.5 year study of vibrational control of chemical reactors are presented. Objectives were experimental study of vibrational control of a CSTR with a homogeneous liquid phase reaction, and development of the theory of vibrational control for nonlinear systems with multiple (nonzero) steady states. A pilot plant unit has been constructed to conduct the experiments. The unit consists of two storage tanks, a CSTR, digital thermometers and two automatic control valves. A theoretical and numerical investigation of the chosen reaction system (the second order exothermic reaction between sodium thiosulfate and hydrogen peroxide in aqueous solution) have been conducted. An experimental study of the vibrationally controlled pilot plant unit and the chosen reaction system has been undertaken. The experiments revealed good agreement between the predictions of the theory and the plant measurements.

48278 **(DPST—84-528) Plasma separation process for generic isotope separation.** Lukosius, E.J. (TRW, Inc., Cleveland, OH (USA)). 1984. Contract AC09-76SR00001. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84015771.

48279 **(INIS-mf—8859) Steam condensation on hygroscopic aerosol particles.** Jaehnert, B. (Frankfurt Univ. (Germany, F.R.). Naturwissenschaftliche Fakultaet). 28 Mar 1983. 160p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number DE84780573.

In the investigations reported here the growth of sodium chloride particles in a moist atmosphere was determined experimentally. To this end, the sodium chloride particles were passed through a vertical, temperature regulated measuring tube, the inner wall of which was maintained moist with distilled water.

48280 (INIS-mf—9040, pp 97-100) **Leaching behaviour of metal hydrides containing immobilized tritium.** Miller, J.M. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

48281 **(NUREG—0935) Acoustic wave propagation in fluids with coupled chemical reactions.** Margulies, T.S.; Schwarz, W.H. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). Aug 1984. 44p. NTIS, PC A03/MF A01 = GPO* $3.75. File Number TI85900054.

This investigation presents a hydroacoustic theory which accounts for sound absorption and dispersion in a multicomponent mixture of reacting fluids (assuming a set of first-order acoustic equations without diffusion) such that several coupled reactions can occur simultaneously. General results are obtained in the form of a biquadratic characteristic equation (called the Kirchhoff-Langevin equation) for the complex propagation variable chi = $-(\alpha + i\omega/c)$ in which α is the attenuation coefficient, c is the phase speed of the progressive wave and ω is the angular frequency. Computer simulations of sound absorption spectra have been made for three different chemical systems, each comprised of two-step chemical reactions using physico-chemical data available in the literature. The chemical systems studied include: (1) water-dioxane, (2) aqueous solutions of glycine and (3) cobalt polyphosphate mixtures. Explicit comparisons are made between the exact biquadratic characteristic solution and the approximate equation (sometimes referred to as a Debye equation) previously applied to interpret the experimental data for the chemical reaction contribution to the absorption versus frequency. The relative chemical reaction and classical viscothermal contributions to the sound absorption are also presented. Several discrepancies that can arise when estimating thermodynamic data (chemical reaction heats or volume changes) for multistep chemical reaction systems when making dilute solution or constant density assumptions are discussed.

48282 **(TVA/PUB—84/75) Urea phosphate as granular or fluid fertilizers.** Blouin, G.M. 1984. 13p. (CONF-8404174—4). NTIS, PC A02/MF A01. File Number DE85900073.

From TFI-TVA fertilizer technology workshop; Huntsville, AL, USA (17 Apr 1984).

Studies are being conducted of the production and agronomic characteristics of the phosphoric acid-urea adduct, urea phosphate, and of the various granular and fluid fertilizers that can be produced from it. Flowsheets are given for the production of urea phosphate. Characteristics of unpurified and purified urea phosphate are also given. (DLC)

48283 **Divalent lanthanide chemistry. Preparation and crystal structures of sodium tris[bis(trimethylsilyl)amido]europate(II) and sodium tris[bis(trimethylsilyl)amido]ytterbate(II), $NaM[N(SiMe_3)_2]_3$.** Tilley, T.D.; Andersen, R.A.; Zalkin, A. (Univ. of California, Berkeley). *Inorganic Chemistry;* **23**: No. 15, 2271-2276(18 Jul 1984). Contract AC03-76SF00098.

A new synthetic method for high-yield preparations of the divalent silylamides $M[N(SiMe_3)_2]_2[MeOCH_2CH_2OMe]_2$, where M is Eu or Yb (Me methyl), has been developed that involves reaction of MI_2 and $NaN(SiMe_3)_2$ in $MeOCH_2CH_2OMe$. Reaction of EuI_2 and $NaN(SiMe_3)_2$ in Et_2O (ethyl ether) yields $NaEu[N(SiMe_3)_2]_3$. Reaction of YbI_2 with $NaN(SiMe_3)_2$ in Et_2O yields two products depending upon the crystallization conditions. If Et_2O is used, $Yb[N(SiMe_3)_2]_2(OEt_2)_2$ is isolated. In contrast, if toluene is used, $NaYb[N(SiMe_3)_2]_3$ is isolated. The structures were refined to conventional R factors of 0.031 (6757 data, $F^2 > \sigma(F^2)$) for the Eu complex and 0.056 (2546 data, $F^2 > 3\ \sigma(F^2)$) for the Yb complex. In the europium complex there are two crystallographically distinct, but chemically equivalent, molecules. The molecular structures of the Eu and Yb complexes are similar. The lanthanide atom bonds to one of the silylamide ligands exclusively and shares the two others with the sodium atom. The Eu-N and Yb-N (unshared) distances are 2.46 (1) and 2.38 (2) A, respectively; the average Eu-N and Yb-N (shared) distances are 2.55 (2) and 2.46 (2) A, respectively; the average Na-N distance is 2.46 (1) A. Several noteworthy close contacts between the metal ions and methl carbon atoms have been noted, i.e. Na-C = 2.71 A, Eu-C = 2.97 A, and Yb-C = 2.86 A. 16 references, 4 figures, 4 tables.

48284 **Synthesis of tin-tellurium polyanions: structure of $(Me_4N)_4Sn_2Te_6$.** Huffman, J.C.; Haushalter, J.P.; Umarji, A.M.; Shenoy, G.K.; Haushalter, R.C. (Indiana Univ., Bloomington). *Inorganic Chemistry;* **23**: No. 15, 2312-2315(18 Jul 1984). Contract W-31-109-ENG-38.

The reaction of KSn with Te at high temperature gives congruently melting K_4SnTe_4 (1) and Sn. Aqueous extraction and workup of the crude K_4SnTe_4 alloy give nearly quantitative yields of K_4SnTe_4 identified by ^{119}Sn and ^{125}Te NMR, ^{119}Sn Moessbauer, and Raman measurements. Depending on the cation and solvent used, a variety of products can be isolated from solutions of $SnTe_4{}^{4-}$ including $Te_4{}^{2-}$ and $Sn_2Te^{4-}{}_6$. The compound [methyl]$(Me_4N)_4Sn_2Te_6$, which was structurally characterized, is isostructural with B_2H_6 and exhibits effective D/sub 2h/ symmetry. The ditinhexatelluride (4-) anion crystallized in the monoclinic space group $P2_1/c$ with lattice constants at -168°C of a = 11.229 (5) A, b = 13.590 (6) A, c = 12.67 (7) A, and β = 116.96 (2)° with Z = 2. The x-ray data were refined to residuals of R = 0.0296 and R/sub w/ = 0.0312, giving terminal Sn-Te distances of 2.700 (2) and 2.689 (1) A and bridging Sn-Te distances of 2.794 (1) and 2.804 (1) A. 32 references, 5 figures, 3 tables.

48285 **Preparation of $[Nb(eta^5\text{-}C_5Me_5)Cl_2]_2$ and $Nb(eta^5\text{-}C_5Me_5)(3\text{-hexyne})Cl_2$.** Belmonte, P.A.; Cloke, F.G.N.; Theopold, K.H.; Schrock, R.R. (Massachusetts Inst. of Tech., Cambridge). *Inorganic Chemistry;* **23**: No. 15, 2365-2367(18 Jul 1984). Contract AC02-78ER04949.

$NbMe_2$(dimethyl)Cl_3, prepared from $NbCl_5$ and $ZnMe_2$, reacts well with LiC_5Me_5 to yield $Nb(eta^5\text{-}C_5Me_5)Me_2Cl_2$. This substance reacts relatively rapidly with molecular hydrogen to produce a green crystalline compound which is similar to $[Ta(eta^5\text{-}C_5Me_5)ClH]_2$ in color and form. Evidence is presented to suggest that the Nb product is not in the hydride form and is $[Nb(eta^5\text{-}C_5Me_5)Cl_2]_2$. The ir spectrum and the ^{1}HNMR signal do not show the presence of the hydride. The mass spectrum of the product prepared in a reaction in which H_2 was used and one in which D_2 was used each exhibits only a parent ion consistent with $[Nb(eta^5\text{-}C_5Me_5)Cl_2]_2$. The dimer formulation is supported by experimental results, as well. The dimer reacts with 3-hexyne to prouce a purple analogue of the Ta acetylene complexes, $NB(eta^5\text{-}C_5Me_5)$(3-hexyne)Cl_2. 17 references.

48286 **Ionic fluids.** Pitzer, K.S. (Univ. of California, Berkeley). *Journal of Physical Chemistry;* **88**: No. 13, 2689-2697(21 Jun 1984). Contract AC03-76SF00098.

The statistical mechanics and thermodynamics of ionic fluids are reviewed and discussed on a corresponding-states basis and with emphasis on areas of recent advances. First, the vapor-liquid and critical properties are considered for pure ionic fluids such as NaCl as well as for the primitive ionic model. The underlying reasons are discussed for differences between fluids of ions and those of neutral molecules. Then, systems involving a solvent are considered with emphasis on simple systems showing phase separation or with strong ion pairing. Estimates are made for the critical curve for the system NaCl-H_2O to the critical point of pure NaCl at 3900 K. 56 references, 13 figures, 4 tables.

48287 **Mechanism of carbon-carbon bond formation in the reaction of 1,2-disubstituted alkenes with a cationic bridging methylidyne iron complex.** Casey, C.P.; Meszaros, M.W.; Marder, S.R.; Fagan, P.J. (Univ. of Wisconsin, Madison). *Journal of the American Chemical Society;* **106**: No. 12, 3680-3681(13 Jun 1984).

Two independent lines of evidence are presented to establish that the reaction of $[(C_5H_5)_2(CO)_2Fe_2(\mu\text{-}CO)(\mu\text{-}CH)]^+\,PF_6{}^-$ cis-2-butene and trans-2-butene, and 1-methyl cyclohexane, occurs by hydrocarbation followed by equilibration. 9 references.

48288 **Reactivities of activated metal carbonyl clusters. Ligand substitution kinetics of the methoxycarbonyl adduct $Ru_3(CO)_{11}(CO_2CH_3)^-$.** Anstock, M.; Taube, D.; Gross, D.C.; Ford, P.C. (Univ. of California, Santa Barbara). *Journal of the American Chemical Society;* **106**: No. 12, 3696-3697(13 Jun 1984).

Reported are results of a kinetic study which demonstrates that the methylcarbonyl adduct $Ru_3(CO)_{11}(CO_2CH_3)^-$ is much more labile than its parent compound $Ru_3(CO)_{12}$. Reaction of the adduct with trimethylphosphite in 10/90 tetrahydrofuran/CH_3OH under CO and excess $P(OCH_3)_3$ produced $Ru_3(CO)_{11}P(OCH_3)_3$. A reaction mechanism is proposed. A value for the equilibrium constant has been calculated: 10.4 +- 1.15^{-1} at 25°C. ΔH = 12 +- 2 Kcal/mol and ΔS = -13 +- (cal/K)/mol. The marked enhancement of the substitution lability of the trinuclear clusters upon forming the methoxycarbonyl adducts is significant. The half-life (0.0875) of the equation is 3 orders of magnitude shorter than that observed for the reaction of $Ru_3(CO)_{12}$ under analogous conditions. 16 references, 1 figure.

48289 **Tertiary phosphine complexes of trivalent uranium: preparation and structure of $U(BH_4)_3(dmpe)_2$ (dmpe = $Me_2PCH_2CH_2PMe_2$).** Wasserman, H.J.; Moody, D.C.; Ryan, R.R. (Los Alamos National Lab., NM (USA)). *Journal of the Chemical Society, Chemical Communications;* No. 8, 532-533(15 Apr 1984).

$U(BH_4)_3(THF)$sub(x) (THF = tetrahydrofuran) reacts cleanly with excess of dmpe (dmpe = $Me_2PCH_2CH_2PMe_2$) producing $U(BH_4)_3(dmpe)_2$; an X-ray structural analysis of this molecule has been carried out revealing U-P(1) = 3.139(8) and U-P(2) = 3.051(9) A.

48290 **Bimolecular and three-body quenching of Paschen (1s) neon atoms by H_2 and O_2.** Beno, M.F.; Firestone, R.F. (Ohio State Univ., Columbus). *Journal of Physical Chemistry;* **88**: No. 8, 1559-1563(12 Apr 1984). Contract AC02-76ER01116.

Effects of H_2 on the kinetics of decay of $Ne(^1P_1,\ ^3P_{0\ 1\ 2})$ atoms and of O_2 on the kinetics of decay of $Ne(^1P_1)$ atoms have been determined in dilute gaseous solutions of H_2 and of O_2 in Ne at 298 K and at Ne pressures in the 400-800-torr region. Bimolecular quenching rate constants for Ne(1s)/H_2 pairs have been observed to increase in the order of increasing Ne(1s) energy. Bimolecular quenching of $Ne(^1P_1)$ atoms by O_2 is over twice as efficient as that by H_2. Three-body quenching by H_2 has been observed for each of the triplet Paschen (1s) species and is identified with collisional relaxation of rovibrationally excited bound-state Ne_2 excimers by H_2 molecules.

4003 Organic Chemistry

REFER ALSO TO CITATION(S) 40030047456, 48250, 48275, 48283, 48284, 48285, 48287, 48288, 48289

48291 **(AD-A—141751/8) Nuclear magnetic resonance studies of molten salts. Progress report 1 January-31 December 1983.** Reynolds, G.F.; Wilkes, J.S.; Levisky, J.A.; Fannin, A.A. Jr. Dec 1983. 39p. (FJSRL-TR—83-0006). NTIS, PC A03/MF A01.

This report describes work in the areas of the measurement and interpretation of 13C NMR chemical shifts of room temperature molten salts of various composition formed from aluminum chloride and 1-methyl-3-ethylimidazolium chloride; the measurement and interpretation of 25Al NMR lineshapes as a function of temperature and melt composition; the NMR study of the reaction of acidic AlCl3/1-methyl-3-ethylimidazolium molten salt with dissolved chlorine; and the redistribution of halide on aluminum during the mixing of acidic chloride and bromide melts in acetonitrile solvent. As part of the study of the effect of temperature on the 27Al NMR lineshapes of the molten salts, a computer program is given which uses a matrix method to simulate NMR lineshapes as a function of chemical shifts and exchange rates.

48292 **(LBL—18278) Ab intio studies of some unique molecular systems.** Fitzgerald, G.B. (Lawrence Berkeley Lab., CA (USA)). Aug 1984. Contract AC03-76SF00098. 95p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85002066.

Thesis.

The first of several unrelated ab initio studies is a study of the ground and first excited states of the three smallest cycloalkynes: cyclopropyne, cyclobutyne, and cyclopentyne. The $^1A_1$ ground state of cyclopropyne is predicted to be a transition state, while the ground state of cyclobutyne is a minimum on the potential energy hypersurface. Cyclobutyne is therefore predicted to be the smallest observable cycloalkyne. Cyclopentyne is not a relative minimum in C/sub 2v/ symmetry but is probably a stable species if allowed to relax to C/sub s/ point group symmetry. Effects of electron correlation are required in order to make these predictions; at the single-configuration Hartree-Fock level of theory, none of these molecules is a minimum in its ground state. Studies of the hydroperoxyl dimer, $(HO_2)_2$, indicate that the cyclic, two-hydrogen-bond form is a minimum on the energy surface and is energetically lower than two separated HO_2 molecules by 4.88 kcal/mole. This form of the dimer contains two long, weak hydrogen bonds, each about half as strong as that of the water dimer. Several other structures of the HO_2 dimer are found to be energetically unfavorable. Finally, a method for performing variational self-consistent-field calculations on excited singlet states of the same symmetry as the ground state is presented. Extensions of this technique to evaluate the first and second energy derivatives with respect to nuclear motion are developed. Applications of this method to the $^1(\pi \rightarrow \pi^*)$ state of formaldehyde show that the method is capable of predicting reasonably accurate excitation energies. A full geometry optimization of this state reduces the excitation energy by about 2.3 eV from the vertical excitation energy. Evaluation of the harmonic vibrational frequencies demonstrates that this state is a minimum in C/sub 2v/ symmetry, while the $^3(\pi \rightarrow \pi^*)$ is a minimum only in C/sub s/ symmetry.

48293 **(PB—84-215102) Laser-induced free radical reactions. Annual report February 1983-January 1984.** Clark, J.H. (California Univ., Berkeley (USA). Dept. of Chemistry). Feb 1984. 33p. NTIS, PC A03/MF A01.

The solvation dynamics of electronically excited 4-aminophthalimide in n-propanol are investigated using picosecond time-resolved emission spectroscopy. The results are discussed in terms of the predictions of a two-state model and a continuum solvation model.

48294 **Synthesis and crystallographic characterization of a gallium salicylaldimine complex of radiopharmaceutical interest.** Green, M.A.; Welch, M.J.; Huffman, J.C. (Washington Univ. School of Medicine, St. Louis, MO). *Journal of the American Chemical Society;* **106**: No. 12, 3689-3691(13 Jun 1984). Contract AC02-77EV04318.

The synthesis and structural characterization of the Ga complex of 1,1,1-tris((5-methoxysalicylaldimino)methyl)ethane is reported. The ligand affords an uncharged gallium complex with a crystallographic 3-fold axis passing through the Ga atom and the ethyl carbon atoms. The ligand occupies all 6 coordination sites about the metal by bonding through the lone pairs of the 3 imino N atoms and the three deprotonated phenolic 0 atoms. The Ga-N and Ga-O bond lengths lie in the range of values reported for octahedral Ga(III) complexes. The C-N, C-O, and C-C bond are identical to those reported for the Co(III) complex of cic,cis-1,3,5-tris(salicylaldimino)cyclohexane, Co[(sal)$_3$tach]. The smaller twist angle of the gallium complex (52.4°) can be attributed to the greater flexibility of the ligand the absence for d^{10} Ga of a ligand field stabilization energy which favors antiprismatic geometry for the Co(III) complex. 37 references, 1 figure, 1 table.

48295 **Aggregation of double-tail sulfonate surfactants probed by ^{23}Na NMR.** Kilpatrick, P.K.; Miller, W.G. (Univ. of Minnesota, Minneapolis). *Journal of Physical Chemistry;* **88**: No. 8, 1649-1655(12 Apr 1984).

Analysis of sodium-23 NMR chemical shift and line-width data on sodium 4-(1-heptylnonyl)benzenesulfonate (SHBS) in water at 47°C indicates the surfactant continuously aggregates in an anti- or weakly cooperative manner up to the surfactant solubility limit, a point beyond which a hydrated lamellar phase is in equilibrium with the surfactant-saturated isotropic solution. By contrast, sodium bis(2-ethylhexyl) sulfosuccinate (Aerosol OT) shows little if any aggregation up to the point of a highly cooperative micellization. Both chemical shift and line-width data indicate the presence of an isotropic solution-liquid crystal phase boundary; the line shape of a biphasic mixture of isotropic solution and lamellar liquid crystal is not motionally averaged, in contrast to a micellar solution, and thus differentiation between micelle formation and solubility boundary is possible. A multiple equilibrium treatment of stepwise amphiphile aggregate formation is used to model both highly cooperative surfactant association, i.e., micellization, and anti- or noncooperative association. The sodium counterion binding to surfactant aggregates was modelled by assuming the oligomers are spherical and have a constant surface charge density with all anionic head groups residing at the surface of the sphere. It was then assumed that the sodium ion exists in one of two environments: free or bound, each having a characteristic chemical shift and transverse relaxation rate. On the basis of a comparison of the model with experimental data, it was concluded that SHBS aggregate concentration decreases with increasing aggregate size; i.e., the aggregation is non- or weakly anticooperative, while Aerosol OT associates very cooperatively, the large degree of cooperativity being an indication of micelle formation.

48296 **Electron spin resonance investigator of the 5-halouracil and 5-halocytosine π-cations produced by attack of the Cl_2^- radical.** Sevilla, M.D.; Swarts, S.; Riederer, H.; Huettermann, J. (Oakland Univ., Rochester, MI). *Journal of Physical Chemistry;* **88**: No. 8, 1601-1605(12 Apr 1982).

The π-cation radicals of a number of 5-halopyrimidines have been produced by attack of the one-electron oxidizing agent, Cl_2^-, n γ-irradiated basic 12 M LiCl glasses at low temperatures. Analysis of the ESR spectra for the π-cations was completed with the inclusion of nuclear quadrupole terms for Cl, Br, and I, in addition to the hyperfine and g tensors. The halopyrimidines investigated were 5-fluorouracil, 5-chlorouracil, 5-bromouracil, 5-iodouracil, 5-fluorocytosine, and 5-bromocytosine. The results for the halouracil π-cations are found to be in agreement with previous results found for the N-1 deprotonated cations identified in single crystals and acid glasses. The halocytosine π-cations gave evidence for a further reaction after production by Cl_2^- attack. Both the 5-fluorocytosine and 5-fluorouracil π-cation radicals show large fluorine couplings (A/sub zz/ = 150 G) and a single nitrogen coupling (A/sub zz/ = 13 G) at low temperatures. However, in the case of 5-fluorocytosine warming results in the conversion of the original π-cation to a new species whose fluorine splitting decreases dramatically to 115 G while two nitrogen splittings are found of nearly equal magnitude (A/sub zz/ = 16 G). These results are shown to be excellent evidence that deprotonation of the exocyclic nitrogen has taken place. Similar results are found with 5-bromocytosine. The reduction of the halogen splitting after deprotonation of the exocyclic nitrogen in 5-fluorocytosine and 5-bromocytosine is suggested to be a result of increased delocalization of the unpaired spin onto the exocyclic nitrogen. This is supported by INDO-MO calculations for the protonated and unprotonated structures.

4004 Electrochemistry

REFER ALSO TO CITATION(S) 40040048225

48297 **(DOE/CS/66001—7) Electrocatalysis research. Final report, August 25, 1982-December 30, 1983.** Warren, L.F. (Rockwell International Corp., Thousand Oaks, CA (USA). Science Center). Aug 1984. Contract AI01-81CS66001. 33p. (JPL—9950-926). NTIS, PC A03/MF A01; GPO Dep. File Number DE85000324.

The general field of electrocatalysis, from both the technical and business standpoints is accessed and research areas and approaches most likely to lead to substantial energy/cost savings are identified. Our overall approach was to compile and evaluate available information, relying heavily on inputs/recommendations of research managers and technical personnel in responsible positions in industry and at universities. Some promising approaches identified to date include the use of transition metal compounds as electrocatalysts and the use of the new electrochemical photocapacitance spectroscopy (EPS) technique for electrocatalysts characterization/development. For the first time, an oxygen electrocatalyst based on the K_2NiF_4 structure was synthesized, investigated and compared with a perovskite analog. Results show that this class of materials, based on Ni^{3+}, forms very efficient and stable O_2 anodes in basic solution and suggests that other structure-types be examined in this regard. The very difficult problem of dinitrogen and carbon dioxide electro-reductions is addressed through the use of biological model systems which can mimic the enzyme processes in nature. While the electrolytic reduction of N_2 and CO_2 is not likely to be applied on a large commercial scale, it may prove to be of great importance for manned space vehicle applications. Our approach was to apply to the electrode surface model systems which complex N_2 and/or CO_2; these would then be reduced in an aqueous or protic environment to generate N_2H_4, NH_3, CH_3OH, etc. Transition metal phosphine complexes were chosen as the models. 3 references, 1 figure, 1 table.

48298 **Electrochemical reduction of aqueous bicarbonate to formate with high current efficiency near the thermodynamic potential at chemically derivatized electrodes.** Stalder, C.J.; Chao, S.; Wrighton, M.S. (Massachusetts Inst. of Tech., Cambridge). *Journal of the American Chemical Society;* **106**: No. 12, 3673-3675(13 Jun 1984).

The preparation of the Pd impregnated polymer, [(PQ^{2+})/sub n/] on W or Pt electrodes is described. The results of the electrochemical reduction of aqueous bicarbonate to formate is reported. The ^{13}C NMR does not reveal any other reduced carbon-containing products. A comparison of charge passed and formate produced shows a high current efficiency. The reduction of bicarbonate occurs within 80 mV of the standard potential. 11 references, 1 figure, 1 table.

48299 **(AI-Trans—254) Polarograms of alkali metal nitrite melts.** Razumovskaya, O.N.; Protsenko, P.I. Translated from *Ukrainskii Khimicheskii Zhurnal (Russian Edition) ;* **33**: 261-264(1967). 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84017337. DE84017337

Cathode and anode polarograms of melts of nitrites of lithium, sodium, potassium, rubidium, cesium, and the eutectics $NaNO_2 + KNO_3$, $NaNO_2 + KNO_2 + Ba(NO_2)_2$ are obtained. It is established that large residual currents which make difficult the determination of nitrite dissociation potentials are characteristic for cathode polarograms. The residual voltages are studied as a function of the temperature, electrode material, and composition of the melt.

4005 Photochemistry

REFER ALSO TO CITATION(S) 40050047576, 48317

48300 **(AD-A—140006/8) Mechanisms of photochemical reactions of transition metal complexes: excited state electron transfer and organometallic photochemistry. Interim technical report.** Wrighton, M.S. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Chemistry). 20 Mar 1984. 13p. (TR—42-ONR). NTIS, PC A02/MF A01.

This article summarizes two major areas of research, electron transfer and organometallic photochemistry, addressed during the last dozen or so years. The article emphasizes aspects of the mechanisms of photochemical reactions of transition metal complexes in these two areas. Excited state electron transfer and photoreactions of organometallic complexes have been, and will be, major areas of research opportunity. Practical applications may come in the fields of energy conversion and catalysis.

48301 **(DOE/ER/10544—1) Strati-bis porphyrins: a promising gauge for study of photo-induced electron transfer. Final summary report.** Mauzerall, D. (Rockefeller Univ., New York (USA)). Feb 1982. Contract FG02-79ER10544. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84017326.

The synthesis of a new series of strati-bisporphyrins (sbPs) is reported. The synthesis via the preparation of the first amide-linked sbP, tetra-meso-[m,m' (N-benzyl benzamide)] strati-bisporphyrin, III. This highly symmetric and well defined staked porphyrin dimer of two meso-substituted tetra phenyl porphyrins joined at the meta positions of all eight phenyl groups by four methyl formamide linkages, -CH_2NHCO-. This sbP is being prepared by the de-novo coupling procedure where a second porphyrin ring is constructed upon an initial porphyrin ring by way of the internal condensation of a porphyrin tetraaldehyde with four pyrrole molecules. This is the same general scheme which was successfully used in the synthesis of the first sbP system which had ester linkages. The necessary porphyrin tetraaldehyde for this new amide-linked dimer has already been synthesized. The porphyrin, tetraaldehyde, T-meso [m-N-benzyl(m'-formyl)benzamide] porphyrin, II, was prepared by the acylation of a porphyrin tetraamine with m-chlorocarbonyl benzaldehyde. The porphyrin tetraamine, tetra-meso-(m-aminomethylphenyl porphyrin, I, was prepared by the condensation of the shiff-base polymer of m-amino-methyl benzaldehyde with pyrrole in the usual way. The most effective synthetic scheme for the sbP III begins with the preparation of the essential benzaldehydes 5 and 9 by the bromination of commercially available toluene derivatives. The fluorescence and other photophysical properties of these molecules will be studied as purified samples are prepared. 3 figures. (DMC)

48302 **UV photodissociation of C_2F_5Br, C_2F_5I, and 1,2-C_2F_4BrI.** Krajnovich, D.; Butler, L.J.; Lee, Y.T. (Materials and Molecular Research Division, Lawrence Berkeley Laboratory and Department of Chemistry, University of California, Berkeley, California 94720). *Journal of Chemical Physics;* **81**: No. 7, 3031-3047(1 Oct 1984). Contract AC03-76SF00098.

The photodissociation reactions of C_2F_5Br, C_2F_5I, and 1,2-C_2F_4BrI have been studied at 248 and 193 nm using the crossed laser-molecular beam technique. Photodissociation of 1,2-C_2F_4BrI was also studied at 266 nm. We find that: (i) C_2F_5Br undergoes C—Br bond fission at 193 nm (but does not absorb at 248 nm); (ii) C_2F_5I undergoes C—I bond fission at 248 nm (but does not absorb at 193 nm); (iii) 1,2-C_2F_4BrI undergoes only C—I bond fission at 248 and 266 nm, but at 193 nm both C—I and C—Br bond fission are observed, with a C—I:C—Br fission ratio of approximately 1.7:1. Center-of-mass recoil energy and angular distributions are determined for each of these photodissociation reactions. These results combined with those of other workers, are used to test simple predictions based on molecular orbital theory. The 266 nm data for C_2F_4BrI provide an approximate value of 19.3 +- 3 kcal/mol for the dissociation energy of C_2F_4Br to C_2F_4+Br and also show that all or almost all the iodine produced in the primary C—I bond fission is in the excited $^{2}P_{1}$/sub //$_{2}$ state. The prospect of doing bond-selective photochemistry in the ultraviolet is discussed.

48303 **Comments on "laser-excited fluorescence of the hydroxyl radical: relaxation coefficients at atmospheric pressure" by C.Y. Chan, R.J. O'Brien, T.M. Hard, and T.B. Cook.** Wang, C.C. (Ford Motor Co., Dearborn, MI). *Journal of Physical Chemistry;* **88**: No. 13, 2922-2923(21 Jun 1984).

The comment points out discrepancies and inconsistencies in conclusions drawn about results by Chan et. al. Data published by a number of other independent experimenters support the supposition that the quenching cross sections of hydroxyl radicals are pressure independent at atmospheric pressure. Data, which led Chan et. al. to claim the existence of a pressure dependence, were measured in oxygen at pressures of 40 torr and higher. At 40 torr, the fluorescence lifetime is already shorter than their laser pulse width by a factor of ca 35. The authors need to improve their temporal resolution by at least one order of magnitude to improve accuracy of measurements. For measurements at higher pressures, still faster excitation and detection will be necessary. 7 references.

48304 **Electron paramagnetic resonance study of $Ph_2P(O)CH_2Cl^-$ trapped in x-ray irradiated (chloromethyl)diphenylphosphine oxide crystals at 3 K and $Ph_2P(O)CH_2$ at 77 K.** Samskog, P.O.; Lee, S.; Arroyo, C.M.; Kispert, L.D.; Geoffroy, M. (Univ. of Alabama, Tuscaloosa). *Journal of Physical Chemistry;* **88**: No. 9, 1804-1807(26 Apr 1984).

The radical $Ph_2P(O)CH_2Cl^-$ is observed in 3 K x-ray irradiated crystals of (chloromethyl)diphenylphosphine oxide. The x-ray irradiation was carried out in the dark. The hyperfine coupling tensors were found to be $A(^{35}Cl)$ = (40.4, 17.9, 16.1, G), $A_1(^{1}H)$ = (24.0, 17.2, 13.1 G), $A_2(^{1}H)$ = (25.0 16.4, 9.0 G), and $A(^{31}P)$ = (42.1, 33.6, 23.8 G). The g-tensor components are equal to 2.0021, 2.0040, and 2.0046. The maximum ^{35}Cl coupling and the minimum g value are located within 5° of the parent C-Cl bond direcction.

48305 **High-temperature photochemistry. Measurements of the rate coefficient for $H + H_2O \rightarrow OH + H_2$ from 1160 to 1390 K.** Madronich, S.; Felder, W. (AeroChem Research Labs., Inc., Princeton, NJ). *Journal of Physical Chemistry;* **88**: No. 9, 1857-1860(26 Apr 1984). Contract AC02-77ER04169.

The high-temperature photochemistry (HTP) technique has been used to study the reaction $H + H_2O \rightarrow OH + H_2(k)$ in the temperature range 1160-1390 K. This reaction is a potential interference in all OH kinetic studies above ca. 1000 K when OH is produced by H_2O flash photolysis. Values of k were determined at 1158, 1274, and 1387 K from OH resonance fluorescence measurements and were fitted by the simple Arrhenius expression (5.2 +- 4.5) x 10^{-10} exp[-(11.1 +- 1.1) x 10^{3}/T] cm^{3} $molecule^{-1}$ s^{-1}.

48306 **(CE-Trans—7988) Photochemical oxidation of hydrogen iodide by oxygen.** Plotnikow, J. Translated from *Zeitschrift fuer Physikalische Chemie, Stoechiometrie und Verwandschaftslehre ;* **58**: 214-244(1907). 34p. NTIS (US Sales Only), PC A03/MF A01. File Number DE84901730. DE84901730

This document is a translation of a classic experiment on the photokinetics of Iodic acid and oxygen. It involves the kinetics of the photochemical reactions of KI and O_2 and HCl. The experiment was performed in 1906. The original data are included as tables.

4006 Radiation Chemistry

REFER ALSO TO CITATION(S) 40060048174, 48303, 48304

48307 **ESR investigation of ester π-cation radicals in a freon matrix at low temperatures: evidence for unusual barriers to methyl group rotation and intramolecular bonding.** Sevilla, M.D.; Becker, D.; Sevilla, C.L.; Swarts, S. (Oakland Univ., Rochester, MI). *Journal of Physical Chemistry;* **88**: No. 9, 1701-1706(26 Apr 1984).

γ-Irradiation of dilute solutions of a number of esters in $CFCl_3$ at 77 K is shown by ESR spectroscopy to produce the π-cation radicals of these molecules. The π-cations formed are those of the methyl and ethyl formates, acetates, and propionates. Larger esters containing propyl and butyl side chains are suggested to be unstable toward deprotonation at 77 K. Synthesis of deuterium-labeled compounds was employed to assign proton hyperfine couplings to specific sites in the π-cation radicals. The π-cations of the ethyl esters show unusually large couplings to the terminal methyl groups. In addition, large barriers to methyl group rotation are found for both the methyl and ethyl ester cation radicals. The large barriers suggest intermolecular bonding between the alkyl group and the carbonyl oxygen in the ester functional group. Such a hypothesis is supported by the finding of a torsional motion in the terminal methyl group of ethyl formate π-cation which has a ca. 1.7 kcal/mol activation energy barrier. It is suggested that a new intramolecular π*-bond is responsible for the formation of cyclic rings in the methyl- and ethyl-substituted ester cation radicals.

4007 Radiochemistry And Nuclear Chemistry

REFER ALSO TO CITATION(S) 40070048289

48308 **(INIS-mf—8787) Investigations on the production of labelled organic compounds by recoil labelling with gamma,n-produced 11-C-atoms.** Wagenbach, U. (Giessen Univ. (Germany, F.R.). Fachbereich Chemie). 22 Sep 1981. 98p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE84780570.

"Hot" ^{11}C atoms are produced from $^{12}C(\gamma,n)$ ^{11}C nuclear reactions by bremsstrahlung at the 65 MeV electron linear accelerator in Giessen. The relative retention in various C-atoms of the amino acid, methionine, is determined by splitting of the terminal C-atoms of the molecule and by independent determination of the content of ^{11}C in the isolated and derived fragments. The terminal groups (thiomethyl or carboxyl groups) each carry approx. 25% of the total retained radioactivity, the remaining 50% being spread over the three inner carbon atoms. The activation of alkylamines, crystallised as hydrochlorides, hydrofluorides, oxalates and sulphates, leads to similar yields of direct labelling from 5 to 15%. Amines activated in the liquid state show a retention of less than 5%. The yields for labelled synthetic products are between 10 and 15% for amino acids and are often higher for crystallised amines. Amines activated in the liquid state produced greater yields of synthesis products but at the same time an increase in the product range. The labelled synthesis products can be separated faster by suitable methods such as preparative HPLC and are then available for carrier-free studies in the life sciences.

48309 (INIS-mf—9040, pp 195-198) **Mechanism of oxidative dissolution of UO_2 under waste disposal vault conditions.** Sunder, S.; Shoesmith, D.W.; Bailey, M.G.; Wallace, G.J. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

48310 (INIS-mf—9040, pp 201-202) **Solution chemistry of technetium and iodine.** Paquette, J.; Lister, S.J.; Lawrence, W. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

48311 (INIS-mf—9040, pp 342) **Practical application of criteria for the clean-up of contaminated communities.** Eaton, R.S. (Atomic Energy Control Board, Ottawa, Ontario (Canada)). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

48312 (INIS-mf—9065, pp 128) **ICOL system for isotope separation and synchrotron radiation.** Kelly, J.C. (New South Wales Univ., Kensington (Australia). School of Physics). Nov 1983. NTIS (US Sales Only), PC A10/MF A01. File Number TI84780622. (CONF-8311183—).

From 3. Australian conference on nuclear techniques of analysis; Lucas Heights, Australia (1 Nov 1983).

48313 **(KFK—131-11) Plutonium-Dokumentation. Volume 1, Number 11. 146 abstracts (No. 3727-4013), with appendix of transplutonium elements.** Brossmann, G.; Buriks, P.; Homma, H.; Kemmerich, M.; Philipp, H.; Schust, G.: Wichmann, E. (comps.). (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)). Nov 1967. 106p. (In German and English). Gesellschoft Fuer Kernforschung, Karlsruhe, West Germany. File Number TI84901927.

This bibliography comprises the following topics: physical properties of plutonium, its alloys, and its compounds; chemistry of plutonium and its compounds, reprocessing, and isotope separation; alloys and metal-metalloid systems with plutonium; and plutonium production by nuclear reactors.

48314 **Preparation and evaluation of 17α-[^{125}I]iodovinyl-11β-methoxyestradiol as a highly selective radioligand for tissues containing estrogen receptors: concise communication.** Hanson, R.N.; Franke, L.A. (Northeastern Univ., Boston, MA). *Journal of Nuclear Medicine;* **25**: No. 9, 998-1002(Sep 1984). Contract AC02-76EV04115.

The moxestrol analog 17α-[^{125}I]iodovinyl-11β-methoxyestradiol was prepared in 95% radiochemical yield from the corresponding 17α-(tributylstannyl)vinyl compound and no-carrier-added sodium [^{125}I]iodide. The new radioligand was evaluated in immature female rats to determine the uptake in and selectivity for tissues containing estrogen receptors. At 1, 2, and 6 hr after injection, the agent demonstrates both high selectivity (uterus to blood ratio) and a high concentration in the largest tissue. The compounds's biologic properties and its ease of preparation suggest that it would be a likely candidate for clinical use as an estrogen-receptor-seeking radiopharmaceutical.

48315 **Kinetics of the reduction of neptunium(VI) by dicarboxylic acids.** Rao, L.F.; Choppin, G.R. (Florida State Univ., Tallahassee). *Inorganic Chemistry;* **23**: No. 15, 2351-2354(18 Jul 1984).

The reduction of tracer concentrations of Np(VI) by dicarboxylic acids has been shown to proceed via formation of the 1:1 metal-ligand complex and to form Np(V) but not Np(IV). The rate constants were in the sequence oxalate $<$ malonate $>$ alkylmalonate $\approx$ succinate $\approx$ phthalate Γ fumarate $>$ glutarate. The results are consistent with a mechanism in which the rate-determining step involves loss of a methylene proton from the reductant. 20 references, 2 figures, 4 tables.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

REFER ALSO TO CITATION(S) 40080047460

48316 **(AD-A—141750/0) Two-step sequential reactions for large activation energies-revisited. Technical summary report.** McConnaughey, H.V.; Ludford, G.S.S. (Wisconsin Univ., Madison (USA). Mathematics Research Center). Apr 1984. 18p. (MRC-TSR—2672). NTIS, PC A02/MF A01.

Sponsored in part by Grant NSF-MCS79-27062.

One-dimensional, steady flame propagation for a sequential, two-step reaction of the form A yields B yields C is considered. An earlier investigation of the problem determines that two separated flames generally exist and that their ordering is fixed by the ordering of the (disparate) magnitudes of the activation energies. The present work shows to the contrary that reversals of the flame ordering are quite possible, but that this is a subtle effect requiring attention to issues which are usually ignored in the theory of single flames.

48317 **(DOE/ER/10396—4) Time-resolved studies of free radicals and laser-initiated chain reactions. Progress report, September 1981-September 1984.** Leone, S.R. (Colorado Univ., Boulder (USA). Dept. of Chemistry). 15 Sep 1984. Contract AC02-79ER10396. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85002100.

Recent progress is described on the study of the reactions, energy transfer, and dynamics of free radicals produced by ultraviolet laser photolysis. These measurements on free radical chain reactions, absolute rate coefficients, and photofragmentation dynamics are carred out by the method of time-resolved infrared emission spectroscopy. Some of the most recent results include development of a new method to obtain a number of absolute rate coefficients for methyl radical reactions. Studies of the dynamics of hot methyl radical reactions reveal that translational excitation is essential in the rate enhancement of several of these reactions. The partitioning of reaction exoergicity into vibrational excitation of the polyatomic products of methyl radical reactions is also studied. Some first rate coefficients are obtained for deactivation of the antisymmetric stretch mode of vibrationally excited methyl radicals with a variety of partners. It is shown that the vibrational and translational temperatures in a laser-initiated chain reaction differ substantially over the course of the chain. This is due to the specific magnitudes of the rate of energy release into vibration and the rate of vibrational deactivation, and is likely to be a general phenomenon. A more complete analysis of slow chain reactions is carried out with full accounting for the excitation and deactivation of multiple product states. The photofragment emission spectrum of vibrationally and rotationally excited CO and CH_3 produced in the photolysis of acetone has been obtained. Laser multiphoton ionization of N_2 is shown to be an alternative means of probing vibrational and rotational temperatures in combusting mixtures.

42 ENGINEERING

REFER ALSO TO CITATION(S) 42000049323

4201 General Engineering

48318 **(SAND—83-2132) Engineering Information Management Systems survey: CADCAM-002.** Fletcher, S.K. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1984. Contract AC04-76DP00789. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85001147.

An immediate goal of CAD/CAM integration in the DOE Nuclear Weapons Complex is automated data transfer/translation between the design, analysis, and manufacturing functions. A longer range goal is to use CAD derived geometric part descriptions as official product definition, rather than the current drawing based product definition. The Engineering Information Management System is described loosely as that software system which performs all the needed functions related to archiving and accessing computer based product definition. Major ingredients of such a system include automated data management, neutral format, engineering databases, information models, and translators. This report surveys the current state of the art in these five areas.

4202 Facilities And Equipment

REFER ALSO TO CITATION(S) 42020047271, 47389, 47393, 47473, 47474, 47475, 47476, 47477, 47894, 48894, 48921, 48922, 49227, 49228

48319 **(AD-A—141688/2) 'Do-it-yourself' fallout/blast shelter evaluation. Final report.** Nash, P.T.; Baker, W.E.; Esparza, E.D.; Westine, P.S.; Blaylock, N.W. (Southwest Research Inst., San Antonio, TX (USA)). Mar 1984. 182p. (SWRI—7531; UCRL—15606). NTIS, PC A09/MF A01.

Expedient fallout shelters recommended to the general public were evaluated for their potential to provide safety to occupants during nuclear blast. The blast threat was in the 2 to 50 psi overpressure range from a 1 megaton (MT) yield weapon. Research included a literature search for expedient shelter designs and evaluations of the designs to certify their ability to protect occupants.

Shelters were evaluated systematically by first analyzing each design for expected failure loads. Next, scale model tests were planned and conducted in the Fort Cronkhite shock tunnel. Structural responses and blast pressures were recorded in a series of twelve experiments involving 96 structural response models. Two rigid models were included in each test to measure internal blast pressure leakage. Probabilities of survival were determined for each of the shelters tested. Expected failure mechanisms were identified for each of the eight U.S. shelters. One shelter, tilt-up doors and earth, was eliminated from consideration because of uncertainties for the associated permanent structure. Failure loads of the remaining seven shelters were determined through analysis. Analyses included failure by overturning/translation, trench collapse, or roof collapse. A car-over-trench shelter was evaluated solely through analysis. The threshold for human tolerance to blast pressures (lung damage) was calculated as 8 psi with a 99 percent survival rate at 28 psi. Thresholds for trench wall stability were calculated based on material strengths and shelter geometries.

48320 (AECD—3874-Rev.) Critical dimensions of untamped conical vessels. Revision. Murray, R. (Oak Ridge Y-12 Plant, TN (USA)). 10 Sep 1984. Contract AC05-84OS21400. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84017416.

The need often arises for determining the critical chemical concentration of uranium solution in the conical bottom of a plant reactor or storage vessel, or the dimension if the concentration is known. This report describes the mathematical analysis of Poisson's equation for a spherical sector, which approximates a right circular cone. The ratio of the critical dimension of an equivalent sphere to the height of the sector for various sector angles is derived from a comparison of first eigenvalues. No description of further relations between composition and dimensions is discussed in the report.

48321 (CONF-8406126—3) Real time algorithms for robotic control of teleoperators. Babcock, S.M.; Barhen, J. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85001137.

From Robots conference; Detroit, MI, USA (4 Jun 1984).

The Department of Energy recently established a Center for Engineering Systems Advanced Research (CESAR) at the Oak Ridge National Laboratory. The Center's charter is to address long-range energy related research in intelligent control systems operating in unstructured environments. The purpose of this paper is to report recent progress toward the development of real-time algorithms, incorporating inverse dynamics, for robotic control of manipulators with backdrivable actuation designed for teleoperation. Parallel state-representation dynamics, concurrent algorithms, and algorithms for manipulators with centralized actuation are discussed. This activity is part of a larger effort with complementary tasks in robot strategy planning, sensor fusion, etc.

48322 (INIS-SU—213) Powerful superconducting switches. Review. Kuroedov, Yu.D. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow). 1982. 47p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE84780560.

Electric circuits of devices with superconducting commutators (SCC), pulsed energy sources (PES) on the base of induction storage rings, devices for protection of electric power lines and cables from reloading at short circuit, protection of magnetic systems and their short circuit, protection of magnetic systems and their short circuit in the regime of frozen field are considered based on literature data. Transients in PES, commutation losses in SCC and methods for their decrease are considered. It results from the analysis of superconducting materials applied as current carrying elements for fast processes in SCC that approximately 5x10^7 W SCC based on NT-50 alloy as finely dispersed cable in Gernam silver matix or as uncovered foil are produced and successfully tested. It is observed from the analysis of the methods for SCC control thermal, magnetic field and current control that field and current control are suitable for fast process SCC. Thermal control is possible only by radiation heating SCC designs, methods for arranging and compounding current carrying elements are also considered.

48323 (KLX—1044) Report of the Instrument and Mechanical Development Department on remote control maintenance shop. (Kellex Corp., New York (USA)). 30 Jun 1949. 61p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE84017624.

The program described herein proposes the use of a remote maintenance shop for maintenance and inspection of vessels, rotating equipment and instruments that have been contaminated by radioactive solutions. The shop area, isolated from the control area by a concrete wall, is viewed in safety by operators in the control area by use of thick transparent liquid windows in the wall. Handling of objects large and small is accomplished by remotely controlled dollies. Manipulation, lifting, and all prehensile operations are performed by mobile overhead arm-like manipulators. Chemical decontamination of small components by remote means is also provided. The designs are specifically applicable to the proposed Bldg. 201-R at Hanford.

48324 (UCRL—90638) Field enhancement of a 12.5-T magnet using holmium poles. Hoard, R.W.; Mance, S.C.; Leber, R.L.; Dalder, E.N.; Chaplin, M.R.; Blair, K.; Nelson, D.H.; Van Dyke, D.A. (Lawrence Livermore National Lab., CA (USA); Lawrence Berkeley Lab., CA (USA)). 7 Sep 1984. Contract W-7405-ENG-48. 13p. (CONF-840937—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84017415.

From Applied superconductivity conference; San Diego, CA, USA (9 Sep 1984).

Unlike conventional ferromagnetic materials such as iron and Supermendur, which produce saturation magnetization fields of approximately 2 T, several of the rare-earth elements (holmium, terbium, erbium, gadolinium, and dysprosium) yield saturated fields of nearly 4 T. This property makes these rare-earth metals particularly attractive as flux concentrators for use in superconducting magnets. This report concerns the use of holmium inserts to enhance the peak useful field of the nominally 12.5-T, 5-cm-bore tape magnet manufactured by the Intermagnetics General Corporation (IGC). Nonlinear magnetostatic analysis indicates that this field increases to nearly 16 T with the rare-earth poles inserted within the bore on both sides of the coil's split-plane radial access gap. This paper focuses on computer modeling methods and experimental results.

48325 Simple, efficient UHV manipulator. Thiel, P.A.; Anderegg, J.W. (Department of Chemistry and Ames Laboratory, Iowa State University, Ames, Iowa 50011). *Review of Scientific Instruments;* **55**: No. 10, 1669-1671(Oct 1984). Contract W-7405-ENG-82.

A simple manipulator is described for use in ultrahigh vacuum. Unhindered rotation within vacuum is provided by a commercial differentially pumped adapter to which the entire XYZ stage is attached. The combination of movements provided by the XYZ stage, the rotating vacuum flange, and a gimbal permits alignment of the sample with any of the peripheral view ports. The resistively heated sample support, mounted through a cold finger, permits rapid variation of sample temperature from several hundred degrees Kelvin to near cryogenic. It is anticipated that this design could be easily used with many existing types of commercial vacuum systems, with the consequent advantage of increased ease and simplicity of both mechanical motion and cryogenic cooling.

48326 Transition from quasiperiodicity to chaos in a Josephson-junction analog. He, D.; Yeh, W.J.; Kao, Y.H. (Department of Physics, State University of New York at Stony Brook, Stony Brook, New York 11794). *Physical Review [Section] B: Condensed Matter;* **30**: No. 1, 172-178(1 Jul 1984).

Experimental observations of the transition from quasiperiodicity to chaos are carried out with an electronic Josephson-junction simulator driven by two independent ac sources. A Poincare section shows an invariant ellipse when the frequency ratio of the two input currents is very close to the reciprocal of the golden mean. The system enters a chaotic state at high input-current amplitudes characterized by a breakdown of the smooth ellipse at the onset of transition. Two convergence ratios are experimentally determined, showing good agreement with calculated values obtained by circle map studies.

48327 **Superconductor stability, 1983: a review.** Dresner, L. (Oak Ridge National Lab., TN). *Cryogenics;* **24**: No. 6, 283-292(Jun 1984).

Superconductor stability, as a characteristic of steady states, is reviewed. Reference is made to internally cooled superconductors, metastable magnets and superfluid helium.

48328 **Frictional heating and convective cooling of polycrystalline diamond drag tools during rock cutting.** Ortega, A.; Glowka, D.A. (Sandia National Laboratories). *SPEJ, Society of Petroleum Engineers Journal;* **24**: No. 2, 121-128(Apr 1984).

A numerical-analytical model is developed to predict temperatures in stud-mounted polycrystalline diamond compact (PDC) drag tools during rock cutting. Experimental measurements of the convective heat-transfer coefficient for PDC cutters are used in the model to predict temperatures under typical drilling conditions with fluid flow. The analysis compares favorably with measurements of frictional temperatures in controlled cutting tests on Tennessee marble. An equation incorporating several drilling parameters is developed to predict the mean operating temperature across the cutter wearflat, defined as that portion of the cutter surface that wears against the rock formation. It is shown that mean wearflat temperatures can be maintained below a maximum safe value of 750°C (1,382°F) only under conditions of low friction at the cutter/rock interface, regardless of the level of convective cooling. The ability of liquid drilling fluids to reduce interface friction is thus shown to be far more important in preventing excessive temperatures than their ability to provide cutter cooling. Because of the relatively high interface friction developed under typical air drilling conditions, it is doubtful that temperatures can be kept subcritical at high rotary speeds in some formations when air is employed as the drilling fluid.

48329 **Performance characteristics of plane-wall venturi-like reverse flow diverters.** Smith, G.V.; Counce, R.M. (Mechanical & Aerospace Engineering Department, University of Tennessee, Knoxville, Tennessee). *Industrial and Engineering Chemistry Process Design and Development;* **23**: No. 2, 295-299(Feb 1984).

The results of an analytical and experimental study of plane-wall venturi-like reverse flow diverters (RFD) are presented. In general, the flow characteristics of the RFD are reasonably well predicted by the mathematical model of the RFD, although a divergence between theory and data is observed for the output characteristics in the reverse flow mode as the output impedance is reduced. Overall, the performance of these devices indicates their usefulness in fluid control and fluid power systems, such as displacement pumping systems.

48330 **Analysis of variance tests to determine the effect of back rake angle on the performance of small diameter polycrystaline diamond rock bits.** Hough, C.L. (Mechanical Engineering Department, Texas A & M University, College Station, Texas). *American Society of Mechanical Engineers, [Paper]*; **84-PET-28**: 8(Feb 1984). (CONF-840201—).

From ASME energy sources technology conference and exhibition; New Orleans, LA, USA (12 Feb 1984).

The effect of back rake angle on a center vacuum bit design was investigated through factorial ANOVA (Analysis of Variance) tests. Multiple performance criteria; penetration rate, specific energy and torque were used in these tests. Thrust and rotary speed were the controlled variables. Results from the ANOVA tests showed that rake angle has a significant effect on penetration rate and torque but not on specific energy. Further tests of means revealed that the 20 degree bit gave the maximum penetration rate although there was no statistical difference among the 15, 20 and 25 degree angles. Tests of means also revealed that the 7 degree bit gives the minimum torque, but is statistically the same as the 15 and 25 degree bits.

48331 **Influence of forced flow on the He II-He I transition in the presence of heat flow.** Caspi, S.; Frederking, T.H.K. (Univ. of California, Berkeley). *Journal of Heat Transfer;* **105**: 846-850(Nov 1983).

The influence of forced flow on the He I-He II, two-phase flow has been studied during heat transfer to superfluid He II in a U-shaped tube, at pressures from 2.4 bar to 10 bar, bath temperatures from 1.6 K to 2.1 K, and flow velocities from zero internally applied speed ("zero net mass flow") to the order of 0.1 cm/s. Within this range of conditions, forced flow (i) did not influence heat transfer prior to phase transitions more than 10 percent; (ii) reduced temperature excursions at lambda phase transitions by a factor of 2 at most with respect to zero net mass flow; (iii) did not influence the limiting heat flux density at initiation of the lambda transition in the supercritical pressure range covered.

48332 **Electron microscopy of Mn-Al-C magnets.** Gau, J.S.; Mishra, R.K.; Thomas, G. (Univ. of California, Berkeley). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Magnetics;* **MAG-19**: No. 5, 2256-2260(Sep 1983). Contract AC03-76SF00098.

The microstructure of warm-extruded Mn-Al-C alloys with and without Ni addition have been characterized using scanning electron microscopy (SEM) and transmission electron microscopy (TEM) with X-ray microanalysis. The existence of finely dispersed Al_2O_3 particles in the extruded magnet is confirmed for the first time. Antiphase domain boundaries were not found, but some grains were disordered. Other microstructural features such as twins and dislocations were characterized and the origin of these features are discussed. The role of Ni in improving the magnetic properties is attributed to its influence on (a) the deformation behavior of the material affecting the texture, (b) the magnetic-exchange interaction between Mn atoms, and (c) the degree of ordering of the tau phase.

48333 **Recirculation of purged flow in an adiabatic counterflow rotary dehumidifier.** Jurinak, J.J.; Mitchell, J.W. (University of Wisconsin Solar Energy Laboratory 1500 Johnson Drive Madison, Wisconsin). *American Society of Mechanical Engineers, [Paper]*; **83-HT-1**: 9(Jul 1983).

The average process stream outlet humidity ratio of an adiabatic counterflow dehumidifier can be lowered if a portion of the process outlet stream is purged from the bulk flow. The purged stream can either be discarded or recirculated and introduced at the inlet of the regenerating period. In this paper, the performance of such a purged counterflow dehumidifier is studied. Two purge geometries that result in a spatially nonuniform inlet condition in the regenerating period are considered. Wave diagram solutions for the limiting case of infinite heat and mass transfer coefficients are used to qualitatively predict the behavior of the purged dehumidifier. A finite difference solution is used to verify the general trends of the approximate wave diagram solutions. The effect of the recirculated purge on the process stream outlet states of high performance silica gel dehumidifiers with low and high thermal capacitance matrices operated at nearly optimal rotational speeds is evaluated.

4203 Lasers

REFER ALSO TO CITATION(S) 42030048388, 48864

48334 **(AD-A—141754/2) Electron impact cross sections for molecular lasers. Final technical report 1 July 1975-30 June 1983.** Wong, S.F. 27 Apr 1984. 33p. NTIS, PC A03/MF A01.

This project deals with electron impact experiments on atoms and molecules relevant to the development of the N_2-CO_2 and rare-gas halide lasers. Cross sections for state-of-state transitions in a variety of collisional processes (rotational, vibrational, and electronic excitation; dissociative attachment) have been determined in the first 4 eV of threshold and are generally found to exhibit great enhancement attributable to resonances. Highlights of the methods of cross-section measurement are also presented.

48335 (AD-A—141889/6) **Computer modeling of pulsed chemical lasers. Final report 1 November 1979-31 October 1983.** Kerber, R.L. (Michigan State Univ., East Lansing (USA). Div. of Engineering Research). 31 Dec 1983. 278p. NTIS, PC A13/MF A01.

Doctoral thesis.

A computer modeling study of pulsed H_2+F_2 and D_2+F_2 chemical lasers has been conducted. This work was directed toward understanding the role of kinetic rotational relaxation and vibrational-rotational relaxation mechanisms in HF and DF lasers. This study resulted in very comprehensive computer models that could predict spectral characteristics of pulsed laser performance using kinetics rate equation data and experimental conditions. In addition, experiments were conducted on a flash initiated pulsed H_2+F_2 laser facility to generate data to compare with the models developed in this study. Models were also developed that demonstrated the performance of pulsed laser driven amplifiers and optical resonance transfer lasers. Finally, simple models were constructed that permit efficient prediction of pulse energy and pulse power.

48336 (CONF-840449—14) **Laser ablation studies using RIS.** Beekman, D.W.; Callcott, T.A. (Tennessee Univ., Knoxville (USA); Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85001118.

From 2. symposium on resonance ionization spectroscopy and its applications; Knoxville, TN, USA (16 Apr 1984).

Here we describe a Resonance Ionization Mass Spectroscopy system which includes a Nd:YAG laser microprobe, multiphoton resonance ionization, a time-of-flight mass spectrometer, and a novel data acquisition system. With this system we have measured the relative population of thermally populated energy levels and the velocity distribution of samarium atoms vaporized by the laser microprobe to determine the excitation and kinetic temperatures, respectively.

48337 (N—84-24433) **Effects of the radial variation of the electric field on some instabilities in lasers and in optical bistability.** Lugiato, L.A.; Milani, M. (Milan Univ. (Italy)). Jan 1984. 3p. NTIS, PC A11/MF A01.

Under proper conditions the stationary state of a homogenously broadened, single mode ring laser can become unstable. The instability requires a bad cavity situation. It was found that self-pulsing behavior in good cavity conditions occurs in optical bistability in a ring cavity filled with a homogeneously broadened atomic sample. In this paper, it is assumed that the electric field has the radial profile of the TEM sub oo mode of a ring cavity with spherical mirrors. In the case of optical bistability, it is assumed that the incident field also corresponds to the TEM sub oo mode. A hypotheses is introduced that (1) the absorption parameter alpha L, with L length of the atomic sample, and the mirror transmissivity coefficient T are both small, with C alpha L/2T arbitrary, (2) the Fresnel number F pi w(2) sub o/lambda sub o L, where w sub o is the beam waist and lambda sub o the wavelength, is large, (3) the atomic system is two-level and homogeneously broadened. In the case that the transverse dimension d of the atomic sample is much smaller than the beam waist w sub o so that only the central part of the beam interacts with the atoms.

48338 (SAND—84-0599C) **Effect of neutron irradiation on the high temperature operation of injection laser diodes.** Barnes, C.E. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 7p. (CONF-840872—29). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85000068.

From SPIE annual technical symposium; San Diego, CA, USA (19 Aug 1984).

Certain optoelectronic applications for which it would be desirable to use an injection laser diode (ILD) require that the light source be exposed to a combined hostile environment of both radiation and high temperature. Because of the complexity of ILD's it is very possible that these two hostile components will have detrimental synergistic effects on the laser. We have studied the effects of fast neutron irradiation on the high temperature ($T \leqq 100^{\circ}$C) operation of ILD's. In general, it was found that the ILD's were more sensitive to irradiation at higher temperatures, and that the lasers with the least temperature variation in threshold current were the least sensitive to irradiation.

48339 **High-power visible GaAlAs lasers with self-aligned strip buried heterostructure.** Ohtoshi, T.; Kawano, T.; Sasaki, Y.; Kajimura, T.; Chinone, N.; Nakamura, M. (Central Research Laboratory, Hitachi, Limited, Kokubunji, Tokyo 185, Japan). *Journal of Applied Physics;* **56**: No. 9, 2491-2496(1 Nov 1984).

Transverse-mode-stabilized GaAlAs high-power visible lasers have been developed in such a way as to have a self-aligned strip buried heterostructure. Analysis of their waveguide properties shows that asymmetric AlAs composition in cladding layers, as well as a thin active layer, are important for increasing optical spot size and stabilizing the transverse mode. Lasers with such a waveguide structure operate in the fundamental transverse mode up to an output power as high as 30 mW, and at a lasing wavelength of around 780 nm under cw operation. In addition, fundamental transverse mode operation up to 75 mW under cw conditions has been achieved with optimization of facet reflectivities.

48340 **Photoacoustic detection of intracavity absorption.** Keller, R.A.; Nogar, N.S.; Bomse, D.S. (Los Alamos National Lab., NM). *Applied Optics;* **22**: No. 21, 3331-3334(1 Nov 1983).

It is demonstrated that the photoacoustic effect in an external cell is a sensitive resonant detector of intracavity absorption. The detection limits for I_2 and Br_2 are 3 ng/cm^3 and 48 ng/cm^3, respectively. For the case of I_2 the detection limit using the photoacoustic detector is essentially the same as the detection limit using a fluorescence detector. The sensitive response of photoacoustic detection to IR absorption makes this technique particularly attractive as a potential resonance detector for intracavity absorption with IR lasers.

48341 **Diffraction loss of stable optical resonators with internal limiting apertures.** Rigrod, W.W. (Los Alamos National Lab., NM). *IEEE (Institute of Electrical and Electronics Engineers) Journal of Quantum Electronics;* **QE-19**: 1679-1685(Nov 1983).

It is pointed out that in many stable laser resonators, the diffraction loss derives principally or even entirely from internal occluding elements with two or more limiting apertures rather than from any mirror size limitations. Resonators of this type, with any number of arbitrarily located circular or rectangular limiting apertures, can be decomposed into a set of equivalent empty symmetric cavities with finite size mirrors. It is shown that when the end mirrors are convex, with radii of curvature greater than the distance to the nearest aperture, the equivalent symmetric cavities are stable. Their diffraction losses are given by the graphs published by Fox and Li (1963), Li (1965), and Kogelnik and Li (1966). Circular and rectangular limiting apertures are discussed as examples of the method. 14 references.

48342 **Spectral and polarization hole burning in neodymium glass lasers.** Hall, D.W. (Corning Glass Works, Corning, NY); Haas, R.A. *IEEE (Institute of Electrical and Electronics Engineers) Journal of Quantum Electronics;* **QE-19**: 1704-1717(Nov 1983). Contract W-7405-ENG-48.

Gain saturation in short-pulse glass laser amplifiers is treated including both spectral and polarization hole burning. A formalism is developed to calculate the performance of an amplifier based on media with a generalized cross section inhomogeneity. Predictions are made for the output fluence and the energy extraction efficiency, as well as the post-pulse gain of a weak probe of arbitrary frequency and polarization. This formalism is applied to a simple model of spectral inhomogeneity in which the medium is assumed to be composed of Lorentzian lines with a Gaussian distribution of line-center frequencies. The polarization inhomogeneity of the stimulated emission cross section is considered, and amplifier performance and results of polarized fluorescence line-narrowing experiments are calculated. Input-output fluences and polarized post-pulse gain ratios are calculated and compared to measurements for a silicate glass amplifier. The predicted gain of a Nd-doped laser glass is compared to published amplifier measurements. Models which successfully predict large-signal performance of glass amplifiers are presented. 37 references.

48343 **Scattering of light and acoustic disturbances in the atomic iodine laser.** Riley, M.E. (Sandia National Lab., Albuquerque, NM). *IEEE (Institute of Electrical and Electronics Engineers) Journal of Quantum Electronics;* **QE-19**: 1209-1216(Jul 1983). Contract AC04-76DP00789.

An analysis is presented of the medium refractive index gradients and associated acoustic disturbances (ripples) observed in photolytically pumped atomic iodine laser oscillators. Coupled equations representing acoustic waves with a heating source, atomic iodine laser pumping and chemistry and the laser field are derived and used to evaluate the time-dependent growth rate of the instabilities in the oscillator. The theoretical, linearized model is found to be capable of accounting for growing instabilities, and the predicted scale size of the disturbance is in agreement with observations.

4204 Heat Transfer And Fluid Flow

REFER ALSO TO CITATION(S) 42040047542, 47840, 47844, 48001, 48175, 48331

48344 **(EGG-M—08284) Critical flashing flow of subcooled fluids in nozzles with contour discontinuities.** Fincke, J.R. (EG and G Idaho, Inc., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 10p. (CONF-840816—16). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84017229.

From 22. national heat transfer conference; Niagara Falls, NY, USA (5 Aug 1984).

A series of experiments was performed to characterize choking in a convergent-divergent nozzle with subcooled upstream conditions. Testing was conducted in a low-pressure flow loop (300 kPa). The variables measured were flow rate, upstream pressure and temperature, and axial-wall and centerline pressure profiles in the nozzle. The data indicate that the departure from thermodynamic equilibrium observed is dependent on radial heat transport in a central liquid jet surrounded by vapor. A description of the phenomena based on a six equation separated flow model was developed. The constitutive equations required to complete the model were derived from analysis of energy transport in the jet and contain derivatives of a dependent variable.

48345 **Guidelines for the instability flow velocity of tube arrays in crossflow.** Chen, S.S. (Argonne National Lab., IL (USA)). *Journal of Sound and Vibration;* **93**: No. 3, 439-455(8 Apr 1984). (CONF-8209249—).

From International conference on flow induced vibrations in fluid engineering; Reading, UK (1 Sep 1982).

Fluid flowing across a tube array can cause dynamic instability. Once large-amplitude oscillations occur, severe damage may result in a short time. Such instability must be avoided in design. This paper presents a brief review of different instability models and stability maps developed based on a semi-analytical model and published experimental data.

48346 **Two-dimensional moving finite element development for prediction of rod thermal quench.** Lemmon, E.C. (EG & G Idaho, Inc., Idaho Falls, Idaho). *American Society of Mechanical Engineers, [Paper]*; **83-WA/HT-31**: 7(Nov 1983). (CONF-831111—).

From ASME winter annual meeting; Boston, MA, USA (13 Nov 1983).

This paper highlights the development of a two-dimensional moving finite element transient conduction algorithm where the nodes are allowed to move in the axial direction. Typical results of the algorithm for the prediction of the rod thermal quench problem are given. The development employs a weighted residuals type method where the interpolation function is dependent on both the moving geometric position and time. Terms in the resulting equations include the unknown time rate of change of both the temperature and nodal positions. In the axial quenching of a cylindrical rod with internal heat generation, the radial positions of the nodes are frozen but the axial positions are free to move to minimize all equation residuals. Using this approach, very few nodes are required in the axial direction to reasonably follow the quenching transient. Quadrilateral ring elements (comprised of triangular ring elements) are used. The difficult external convective boundary condition used is a moving step function where the step location is determined by the quench temperature. Of special interest in the development is the use of the calculus of two-dimensional discontinuous functions in a distributional sense, system regularization, and the alteration of a stiff ordinary differential equation solver to obtain solutions.

48347 **Radiative and convective transfer in a cylindrical enclosure for a real gas.** Smith, T.F.; Shen, Z.F. (Division of Energy Engineering The University of Iowa, Iowa City, Iowa). *American Society of Mechanical Engineers, [Paper]*; **83-HT-53**: 10(Jul 1983).

A study was initiated to develop a model to describe the transport processes in energy generation units as represented by a cylindrical enclosure. Interaction of radiative and convective transfer is considered for hydrodynamically fully developed, laminar or turbulent flow of a radiatively participating gas through a black wall duct with a specified wall temperature or heat flux distribution. Gas and wall temperature or wall heat flux distributions are sought utilizing the zone method to describe the radient exchange process with gas radiative properties furnished by the weighted sum of gray gases model. The analysis demonstrates that temperature or wall heat flux distributions depend on the boundary conditions and several parameters, namely, the Boltzmann number, gas conduction to radiation factor, volumetric heat generation, turbulent Prandtl number, length to tube diameter ratio, and gas radiative properties. Results are presented for representative values of the governing parameters and different boundary conditions. Effects of zone sizes and radiant distances are also of zone sizes and radiant distances are also examined. Results from these later effects are particularly useful in reducing the storage requirements and computational times associated with the zone method.

48348 **Heat transfer from a freezing substance to an immersed tube containing a coolant having arbitrary vibrations of flow rate and inlet temperature.** Stein, E.; Rooz, E.; Shamsundar, N. (Heat Transfer and Phase Change Laboratory Department of Mechanical Engineering University of Houston 4800 Calhoun Houston, Texas 77004). *American Society of Mechanical Engineers, [Paper]*; **83-HT-99**: 8(Jul 1983).

Coupled conduction and convection of heat from a substance which freezes outside a tube to a coolant fluid flowing inside the tube is studied. Earlier papers treated the case where the flow rate of the coolant is constant. This paper adapts the analytical solution of one of these to the case when the flow rate varies with time in an arbitrary way. A special analysis is made to treat sudden jumps in flow rate. The results of the analysis are compared to numerical results obtained by a finite-element calculation. The effects of different ways of varying the coolant flow upon the heat release rate and heat transfer effectiveness are illustrated.

48349 **Two-dimensional energy transfer in radiatively participating media with conduction by the P-N approximation.** Ratzel, A.C. III; Howell, J.R. (Sandia National Lab., Albuquerque, NM). pp 535-540 of Heat transfer 1982. Proceedings of the seventh international conference, Munich, West Germany, September 6-10, 1982. Volume 2. Washington, DC, USA; Hemisphere Publishing Corporation (1982). (CONF-820901—).

From 7. international heat transfer conference; Munich, F.R. Germany (6 Sep 1982).

The combined steady state conduction and radiation heat transfer problem for a gray medium within a rectangular enclosure is considered using the differential approximation. The P-1 and P-3 spherical harmonics approximations for the intensity distribution are incorporated in the equation of transfer, and modified Marshak-type boundary conditions are used in the formulation. The enclosure walls are assumed to be isothermal black surfaces. Two and five coupled second-order nonlinear partial differential equations are developed for the P-1 and P-3 approximations, respectively, using the energy conservation and moment of intensity expressions. The P-1 equations have been numerically solved using finite element techniques, while the P-3 relations have been solved using a finite difference successive-over-relaxation (SOR) algorithm. Two-dimensional temperature profiles and hot wall heat transfer results are presented for square enclosures and different optical width rectangular enclosures for a range of conduction-radiation parameters. 21 references.

48350 **Second-order turbulence model for two-phase flows.** Elghobashi, S.E.; Abou-Arab, T.W. (California Univ., Irvine). pp 219-224 of Heat transfer 1982. Proceedings of the seventh international conference, Munich, West Germany, September 6-10, 1982. Volume 5. Washington, DC, USA; Hemisphere Publishing Corporation (1982). (CONF-820901—). Contract FG22-80PC30303.

From 7. international heat transfer conference; Munich, F.R. Germany (6 Sep 1982).

A second-order turbulence model is proposed for predicting incompressible two-phase flows. Closure is achieved by modeling the turbulent correlations appearing in the equations of the mean motion of both phases, and the kinetic energy of turbulence and its dissipation rate for the carrier fluid. 15 references.

4205 Materials Testing

REFER ALSO TO CITATION(S) 42050048172, 48194, 48195, 48196, 48197, 48198, 48199, 48200, 48201, 48216, 48220

48351 **(BNWL-CC—900) 04 nuclear safety: pressure piping crack monitoring detection of metal overstress by acoustic emission. Progress report, July-September 1966.** Hutton, P.H. (Pacific Northwest Lab., Richland, WA (USA)). 28 Oct 1966. Contract AC06-76RL01830. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84017370.

The three main areas of effort have been: (1) definition of the general acoustic response pattern related to the gross aspects of forming and extending a crack in various materials, (2) development of a monitor system prototype concept exclusive of transducers and (3) development of a suitable, high temperature transducer. Tests using double cantilever beam (DCB) specimens of various materials to establish conditions of crack formation and growth have indicated that material ductility is a major controlling factor in the acoustic response pattern. It appears to effect both acoustic emission intensity and the point in the crack formation-growth sequence at which the main emission occurs. A concept has been developed for the prototype of a full scale monitor system. Hardware development is being limited to the analyzer portion of the system at this time because it is the part most significant to demonstrating feasibility of the intended application. Signal level and signal rate are both being investigated as possible parameters for evaluating acoustic emission data. Of the various transducers for potential high temperature application, the capacitive or electrostatic transducer now looks most promising. A significant improvement in sensitivity has been achieved and a trial model used during recent tests produced generally satisfactory data. The sequence of effort on the program is being adjusted somewhat from that previously outlined. Some of the more detailed investigative phases will receive only moderate attention, temporarily, in favor of first demonstrating the basic feasibility of detecting acoustic emission and making a meaningful analysis under postulated service conditions.

48352 **(FRNC-TH—1455) Medium range energy proton nuclear scattering radiography.** Duchazeaubeneix, J.C. (Paris-11 Univ., 91 - Orsay (France)). Feb 1982. 144p. (In French). NTIS (US Sales Only), PC A07/MF A01. File Number DE84751763.

This thesis is concerned with a new application of the strong nuclear interaction aiming to radiographic analysis. In this work, some physical processes have been analyzed with detail; these processes play a fundamental role in method quality and limitations; they have been detailed to facilitate comprehension to scientists who are not nuclear physicists. To better appreciate specific qualities of the RDN (Radiography par Diffusion Nucleaire), a chapter reviews strong nuclear interaction properties. Then, the experimental device is described, processing and acquisition system. Spatial resolution and sensitivity limits are studied. Results are presented.

48353 (INIS-BR—121, pp 125) **Radiation protection in industrial radiography.** Freire, F.G.M. (AJ Radiografia e Gamagrafia Industrial S/C Ltda (Brazil)). 1983. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. File Number TI84780533. (CONF-8308170—).

From Meeting on medical physics in Rio de Janeiro; Rio de Janeiro, Brazil (25 Aug 1983).

48354 **Sizing effects using annular array techniques with an automatic ultrasonic data acquisition system.** Gieske, J.H.; Stoker, G.C.; Walkington, P.D. (Sandia National Laboratories, Albuquerque, NM). pp 413-424 of Review of progress in quantitative nondestructive evaluation, Vol. 3A. Thompson, D.O.; Chimenti, D.E. New York, NY, USA; Plenum Press (1984). (CONF-830811—).

From Conference on quantitative NDE; Santa Cruz, CA, USA (7 Aug 1983).

This chapter describes an annular phased array system which is being developed for general nondestructive evaluation (NDE) applications on metal and ceramic materials. The annular phased array system is part of a general purpose ultrasonic data acquisition and display system. Phased array techniques enable the electronic changing of the focus of the acoustic beam radiating from a phased array transducer or reflecting from a defect in a solid material. Topics considered include the general computerized ultrasonic data acquisition system, the annular array design, phased array delay time scheduling, and phased array data acquisition. C-scan plots of threshold amplitudes render sizing capabilities by the annular array technique to be largely independent of defect depth and system gain. It is suggested that the programmable phased array controller can and should be improved.

48355 **Ultrasonic microstructural noise parameters in a powder metal alloy.** Tittmann, B.R.; Ahlberg, L.A.; Fertig, K.W. (Rockwell Intl. Science Center, Thousand Oaks, CA). pp 57-64 of Review of progress in quantitative nondestructive evaluation, Vol. 3A. Thompson, D.O.; Chimenti, D.E. New York, NY, USA; Plenum Press (1984). (CONF-830811—).

From Conference on quantitative NDE; Santa Cruz, CA, USA (7 Aug 1983).

This chapter discusses the application of ultrasonic backscattering to the types of powder metallurgy alloys used in the manufacture of aircraft engine disc components. The objective is the development of an integrated model which is able to assess the performance of an ultrasonic engine disc inspection system. Performance is measured by the probability of detecting internal cracks in the presence of competing microstructural noise. The ultrasonic backscattering characteristics are measured for IN-100. A variety of transducers are placed either in a waterbath or in sample contact for a frequency range from about 2 to 18 MHz. Two samples with different micropore densities are used to demonstrate the feasibility of calculating microstructural parameters from the ultrasonic data.

48356 **Calculation of the acoustic material signature of a layered solid.** Mal, A.K.; Kundu, T. (Univ. of California, Los Angeles, CA). pp 1027-1033 of Review of progress in quantitative nondestructive evaluation, Vol. 3B. Thompson, D.O.; Chimenti, D.E. New York, NY, USA; Plenum Press (1984). (CONF-830811—).

From Conference on quantitative NDE; Santa Cruz, CA, USA (7 Aug 1983).

This chapter describes the use of the focused-beam, reflection mode acoustic microscopy (FRAM) to study simple solid specimens. A comprehensive theoretical model of the system in which all of the wave phenomena occurring within the solid are fully accounted for is presented in order to provide a better understanding of the FRAM approach. The main objective of the theory is to calculate the response of a transducer for a wide-angle focused beam reflection mode acoustic microscope operating at relatively high frequencies (MHz range). The aperture of the lens is assumed to be 60° and the frequency of excitation 35 MHz. The solid specimens considered are a stainless steel half space and a fused quartz substrated coated with a copper layer.

48357 **Elements of an ultrasonic inspection protocol for IN100 jet engine materials.** Rose, J.H. (Ames Laboratory, USDOE, Iowa State Univ., Ames, IA). pp 1399-1408 of Review of progress in quantitative nondestructive evaluation, Vol. 3B. Thompson, D.O.; Chimenti, D.E. New York, NY, USA; Plenum Press (1984). (CONF-830811—).

From Conference on quantitative NDE; Santa Cruz, CA, USA (7 Aug 1983).

This chapter presents some generic research results from the ultrasonic inspection of subsurface flaws in IN100 disks. A number of model assumptions are made concerning the expected flaw population. Topics considered include expected flaw distribution, rejectable flaws, an ultrasonic measurement model, and the detection filter. The ultrasonic quantitative nondestructive evaluation (QNDE) program of the Air Force Materials Laboratory has provided three major elements for the ultrasonic inspection protocol: quantitative measurement models, detection filters, and characterization methods (the inverse Born approximation, flash points, etc.). The three elements can be developed into a reliable detection and characterization system if the fatigue cracks encountered during inspection are simple and open. It is concluded that the successful implementation of any ultrasonic inspection technique for subsurface flaws will depend on an accurate characterization of the expected flaw population.

4206 Safety Engineering

REFER ALSO TO CITATION(S) 42060047841, 47854

48358 **(DOE/ET/20356—14) Flat-plate photovoltaic power systems handbook for federal agencies.** Cochrane, E.H.; Lawson, A.C.; Savage, C.H. (Jet Propulsion Lab., Pasadena, CA (USA)). Apr 1984. Contract AI01-76ET20356. 132p. (JPL-PUB—84-35). NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85000330.

The Federal Photovoltaic Utilization Program (FPUP), sponsored by the Department of Energy, has provided an opportunity for 26 federal agencies to install photovoltaic power systems in various types of applications and environments. As the cost of photovoltaic power is reduced, an increasing number of potential, terrestrial, photovoltaic applications become cost effective within these agencies. Certain federal agencies have additional criteria for the use of photovoltaic power systems such as silent operation, reliable power, and independence from the limited availability of grid power of a host country. The primary purpose of this handbook is to provide a tool for personnel in federal agencies to evaluate the viability of potential photovoltaic applications. A second objective is to provide descriptions of various photovoltaic systems installed by different federal agencies under the Federal Photovoltaic Utilization Program so that other agencies may consider similar applications. A third objective is to share lessons learned which are contained throughout the document to enable more effective procurement, design, installation, and operation of future photovoltaic systems. The intent of this publication is not to provide a complete handbook, but rather to provide a guide for federal agency personnel with additional information incorporated by references. This handbook has been organized to present the steps to be followed in selecting, procuring, and installing a photovoltaic application. It is based on lessons learned from FPUP as well as on an overview of FPUP existing applications.

4207 Vacuum Engineering

REFER ALSO TO CITATION(S) 42070048325

4208 Electronic Circuits And Devices

REFER ALSO TO CITATION(S) 42080047870

48359 **(LA—10004) Repetitive pulse generation with inductive energy storage: a new technology for defense.** Honig, E.M. (Los Alamos National Lab., NM (USA)). Apr 1984. Contract W-7405-ENG-36. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84017090.

Many of the weapons concepts proposed for future defense weapons will require bursts of energy at high power and at high repetition rates. This research program has led the way in demonstrating the feasibility of using energy storage to power such systems. An inductive store and a new energy transfer circuit were used to produce a 75-MW, 5-kHz pulse train at a 1-Ω load. With a new high-power opening switch, such transfer circuits have the potential to operate at the 10-GW level. The major results of this program were a increased understanding of the inductive energy storage and opening switch problem, a demonstration of this technology at a very high pulse reptition rate, and the development of new transfer circuits featuring high efficiency and simplicity.

48360 **(SAND—84-0609C) 1500 Gate standard cell compatible radiation hard gate array.** Mills, B.D.; Shafer, B.D.; Melancon, E.P. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1984. Contract AC04-76DP00789. 5p. (CONF-841112—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84016113.

From GOMAC '84 - Government microcircuit applications conference; Las Vegas, NV, USA (6 Nov 1984).

The G1500 gate array combines Sandia Labs' 4/3μ CMOS silicon gate radiation hard process with a novel gate isolated standard cell compatible design for quick turnaround time, low cost, and radiation hardness. This device is hard to 5×10^5 rads, utilizes a configuration that provides high packing density, and is supported on both the Daisy and Mentor workstations. This paper describes Sandia Labs' radiation hard 4/3μ process, the G1500's unique design, and the complete design capabilities offered by the workstations.

48361 **Patterning of tantalum polycide films.** Light, R.W.; Bell, M.B. (Sundia National Lab., Albuquerque, NM). *Journal of the Electrochemical Society;* **131**: No. 2, 459-460(Feb 1984).

Gate level interconnect composed of a layer of doped polysilicon covered by a refractory metal silicide (polycide structure) is becoming an important feature of some integrated circuit technologies. These composite structures retain the relatively well characterized polysilicon/SiO^2 interface while permitting a lower resistivity than possible with polysilicon alone. Dry etching chemistries used for patterning polysilicon are not generally compatible with these composite materials, often producing an undesirable etched line profile or other complications. For example, a fluorine based plasma will typically etch the polysilicon out from under the silicide resulting in an overhang that will reduce step coverage by subsequent depositions. It has been recently shown that by adding $C1^2$ to an SF^6 plasma, a continuous profile can be formed on Ta polycide lines. In this paper the authors discuss the etching behavior of $TaSi^2$/polysilicon films in a $BC1^3/C1^2$ based reactive ion etching process. Control of the etched line profile by variation of the process parameters is emphasized.

4209 Waste Processing Plants And Equipment

REFER ALSO TO CITATION(S) 42090048134

4210 Combustion Systems

REFER ALSO TO CITATION(S) 42100047461

48362 **(PB—84-215268) Advancement of developmental technology for pulse combustion applications. Annual report January 1983-February 1984.** Vishwanath, P.S. Mar 1984. 52p. NTIS, PC A04/MF A01.

This annual report presents the major results in the areas of stand-alone pulse units, mixing and decoupling. A self-starting pulse unit was designed and successfully tested up to an input rate of 100,000 Btu/hr. A setup to generate power from pulse unit exhaust gases was also put together. In the area of decoupling, major factors affecting design of inlet and exhaust decouplers were identified. Changes in these factors affected burner stability, operating frequency and the phase relationship between burner and decoupler pressures. Frequency scan analysis was used to simulate frequency response of several burner/decoupler combinations. In the area of mixing, a multiple pipe pulse unit was fabricated and used to obtain baseline data on mixer head performance.

48363 **Heat transfer to horizontal tubes in a pilot-scale fluidized-bed combustor burning low-rank coals.** Grewal, N.S.; Goblirsch, G. (Mechanical Engineering Department University of North Dakota Grand Forks, ND). *American Society of Mechanical Engineers, [Paper]*; **83-HT-91**: 6(Jul 1983).

Experimental data are obtained for the heat transfer coefficient between immersed horizontal tube bundles and an atmospheric-fluidized-bed combustor burning low-rank coals. Silica sand and limestone are used as bed material. The tests are conducted, with and without limestone addition and ash recycle, at average bed temperatures ranging from 1047 to 1125 K, superficial fluidizing velocity of 1.66 to 2.04 m/s, and excess air levels of 15 to 40 percent. The experimental data are examined in the light of the existing correlations for the heat transfer coefficient. The predicted values of heat transfer coefficient from the correlations proposed by Grewal and Bansal et al. are found to be within + or - 25 percent of the experimental values of heat transfer coefficient, when the contribution due to radiation is also included.

48364 **A staged fluid bed combustor with a reduced heat exchange area.** Porter, J.H.; DeLucia, D.E.; Mohr, C.M.; Park, D.; Sharma, P.K. (Energy and Environmental Engineering, Inc., East Cambridge, MA). *American Society of Mechanical Engineers, [Paper]*; **83-HT-94**: 7(Jul 1983).

A staged fluid bed combustor is described which involves a significant reduction in overall tube heat transfer area. This is accomplished by replacing the convective section of the conventional AFBC by placing the tubes in four to five shallow fluid beds located in a cascade above the combustion zone. Utilizing the high heat transfer coefficients in fluid beds, the "convective" section heat transfer area is cut down by approximately eighty percent. The individual stage temperatures are determined by an optimization process which minimizes total heat transfer area. The required heat transfer coefficients at various temperatures are obtained by adding the radiative contribution to the cold bed values. Economic evaluation of this configuration indicates a savings of twenty percent in boiler capital costs.

48365 **Coal conversion opportunities in Pennsylvania.** Zupko, A.J.; Noland, J.W. pp 183-192 of Advances in energy cost savings for industry and buildings. Atlanta, GA, USA; Fairmont Press (1983). (CONF-831115—).

From 6. world energy engineering congress; Atlanta, GA, USA (29 Nov 1983).

This paper discusses the available boiler coal conversion technologies such as coal-design boilers burning gas or oil, reconversion, reconversion of pulverized coal boilers, reconversion of spreader stoker boilers, boiler replacement, oil-/gas design boilers, direct coal firing, indirect coal firing, and replacement, and considers the potential suitability of these technologies for industrial coal conversion in Pennsylvania. The paper also identifies and evaluates the important economic factors which relate to coal conversion, including, operating and maintenance costs, financing, interest, and return on investment. Finally, a feasibility study for coal conversion in Pennsylvania is presented.

4220 Underground Engineering

REFER ALSO TO CITATION(S) 42200047508

4240 Pollution Control Equipment

REFER ALSO TO CITATION(S) 42400047335, 47346, 47364, 47757

48366 **(DOE/ET/10373—T11) Granular bed filter development program. Monthly report, October 1977.** Nov 1977. Contract AC21-77ET10373. 38p. (FE—2579-14). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE84017652.

This is an intensive program to determine the scientific principle upon which granular-bed filtration operates and to design and construct a Granular-Bed Filter (GBF) device which can be subjected to controlled cold-flow testing for verification of these principles. The objective is to generate the desired information on the cold-flow model for future application, correlation, performance prediction, and implementation on a second-generation GBF hot-flow model. The scope of the cold-flow program incorporates: (1) theoretical analysis, in which the theories and mechanisms of the interaction of exhaust gases and granular media are studied and commuted to mathematical expressions for computer simulation; (2) design and construction of the cold-flow model for parametric testing and correlation with the math model; (3) installation of a particle injection and sampling facility to enable controlled dust injection particle sampling and analysis, and filter performance determination; and (4) evaluation of filter screen deposition phenomena and the effectiveness of various deposit-removing devices. During this report period, computer runs were completed which initiated the correlation studies of simulated versus actual test data. Computer runs were also completed to study the trends in filter performance through alteration of selected variable inputs and in the prediction of hot GBF performance. All planned cold-flow tests were completed and data collected is being compiled and summarized.

4250 Power Cycles

REFER ALSO TO CITATION(S) 42500047743, 47957

43 PARTICLE ACCELERATORS

48367 **(ANL-HEP-CP—84-61) Polarization in chemically doped hydrogen-rich glasses.** Hill, D.; Hill, J.; Krumpolc, M. (Argonne National Lab., IL (USA); Illinois Univ., Chicago (USA)). 27 Aug 1984. Contract W-31-109-ENG-38. 23p. (CONF-8409134—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84017486.

From 4. workshop on polarized target materials and techniques; Bonn, F.R. Germany (2 Sep 1984).

Further results are presented on dynamic polarization in chemically doped glasses consisting of borane complexes dissolved in ammonia and primary amines. Proton polarization > 80% is achieved in a ^{3}He cryostat at 2.5T in glasses containing 16 wt. % hydrogen. In addition to details of the sample preparations and the dependence of the polarization on several sample parameters, information is given on calorimetric properties, polarization of the background ^{11}B spins, and ^{2}H polarization in a deuterated analog material.

4301 Design, Development, And Operation

REFER ALSO TO CITATION(S) 43010048730

48368 **(AD-A—141840/9) Bumpy torus betatron. Interim report.** Chernin, D.; Mondelli, A.; Roberson, C. (Naval Research Lab., Washington, DC (USA)). 22 May 1984. 10p. (NRL-MR—5327). NTIS, PC A02/MF A01.

The combination of a bumpy torus field and a conventional betatron field leads to an interesting strongly-focused, high-current accelerator configuration. The question of orbital stability of a test particle in such a device is discussed and it is shown that the alternating gradient focusing in this accelerator can easily lead to greater than 20% bandwidth in allowed mismatch between the vertical magnetic field and the average beam particle energy.

48369 **(CONF-8404143—23) Large electrostatic accelerators.** Jones, C.M. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85001120.

From 10. international conference on cyclotrons and their applications; East Lansing, MI, USA (30 Apr 1984).

The increasing importance of energetic heavy ion beams in the study of atomic physics, nuclear physics, and materials science has partially or wholly motivated the construction of a new generation of large electrostatic accelerators designed to operate at terminal potentials of 20 MV or above. In this paper, the author briefly discusses the status of these new accelerators and also discusses several recent technological advances which may be expected to further improve their performance. The paper is divided into four parts: (1) a discussion of the motivation for the construction of large electrostatic accelerators, (2) a description and discussion of several large electrostatic accelerators which have been recently completed or are under construction, (3) a description of several recent innovations which may be expected to improve the performance of large electrostatic accelerators in the future, and (4) a description of an innovative new large electrostatic accelerator whose construction is scheduled to begin next year. Due to time and space constraints, discussion is restricted to consideration of only tandem accelerators.

48370 (INIS-mf—9064, pp 29) **Picosecond beam pulsing system using a superconducting resonator on the 14UD.** Weisser, D.C. (Australian National Univ., Canberra. Research School of Physical Sciences). 1984. NTIS (US Sales Only), PC A06/MF A01. File Number TI84780621. (CONF-840216—).

From 10. nuclear physics conference; Canberra, Australia (6 Feb 1984).

48371 **Possible use of synchrotrons as post-acceleration boosters for tandems.** Thieberger, P. (Brookhaven National Lab., Upton, NY (USA). Physics Dept.). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **220**: No. 1, 209-210(15 Feb 1984). (CONF-8304105—). Contract AC02-76CH00016.

From 6. international tandem conference; Chester, UK (16 Apr 1983).

Also published as report BNL—33218.

The recent development of a high intensity negative ion source and the demonstration that intense heavy ion beam bursts can be accelerated by a large tandem make synchrotrons a possibly attractive alternative when considering different types of tandem injected heavy ion booster accelerators.

4302 Beam Dynamics, Field Calculations, And Ion Optics

48372 (BNL—35121) **X-ray ring performance after spring shut down.** Halama, H.J. (Brookhaven National Lab., Upton, NY (USA)). Jul 1984. Contract AC02-76CH00016. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85001942.

This report covers vacuum studies carried out over 4 months' period April to July 1984 including some comments on the shut down. The data rely heavily on partial pressure analysis which is used to calculate beam lifetimes. Discrepancies between these calculated values and the real lifetimes are also discussed and some explanations suggested. An attempt is made to measure synchrotron light desorption and the pumping speed of the distributed ion pumps which appear to be very small at low pressures. It outlines a possible course of action to improve the pumping speed as well as the beam current and its lifetime. At present the lifetimes routinely achieved are 1 h for 50 to 60 mA and several hours 20 to 30 mA at 1.7 to 2 GeV. Fast beam drop-outs are not directly pressure related but are caused by other mechanisms. They present a serious problem and vary greatly with day to day operation. Equipment failure may be an important contributor to this problem.

48373 (DESY-L-Trans—288) **Perturbed transverse motion of charged particles in cyclic accelerators (colliders).** Simonyan, K.A. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Mar 1984. 48p. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.).

The perturbed transverse motion of particles in cyclic accelerators (storage rings) is analysed in detail. The amplitude of betatron oscillations around the perturbed closed orbit is shown to essentially depend on the perturbation magnitude, unlike the existing theory. Considered are the examples of the most frequently used field perturbations for the correction of the guiding magnetic field, the extraction of the beam from the accelerator and its engagement to the internal target. Examples are given of the time dependence of perturbations, when the presence of perturbations weakly affects the beam dimensions.

48374 (FNAL-TM—1280) **Bunch coalescing in the main ring to form intense proton and antiproton bunches without RF counterphasing.** Griffin, J.E.; MacLachlan, J.A.; Nicholls, G.N.; Qian, Z.B. (Fermi National Accelerator Lab., Batavia, IL (USA)). 9 Aug 1984. Contract AC02-76CH03000. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85001364.

Both the proton and antiproton bunches which will collide in the Tevatron have longitudinal emittance greater than can be accelerated by the main ring from 8 GeV without large loss and emittance growth. We have previously described the technique of combining several smaller bunches at the Tevatron injection energy with little increase in the total emittance and negligible loss. This technique requires adiabatic debunching of several adjacent 53 MHz bunches by smooth reduction of the RF voltage from ~ 1 MV to ~ 100 V. The very low voltage is extremely difficult to attain with a high-Q system designed for megavolt accelerating potential. The counterphasing technique of voltage reduction which we have used in main ring experiments and proposed for the TeV I project is to divide the accelerating cavities into two closely matched groups and to smoothly shift the relative phase of the drive to the two groups by 180 degrees. When the net voltage has been reduced by this means to the lowest practical level, about 10 kV, the final voltage reduction may be performed by turning off the high-Q system and using a low-Q cavity. The voltage induced on the undriven gaps of the high-Q system is low enough not to be a major problem because the total intensity is low. However, the effects are not negligible, and dynamic beam loading compensation is required. This memo proposes that the process described above be simplified somewhat by replacing the counterphasing voltage reduction with a zero-voltage spreading of the bunches for several milliseconds followed by a few hundred microseconds of rotation to minimum energy spread in buckets produced at high voltage.

48375 (INIS-mf—9065, pp 119-121) **Ion optics of the Melbourne University 5U Pelletron.** Colman, R.A.; Legge, G.J.F. (Melbourne Univ., Parkville (Australia). School of Physics). Nov 1983. NTIS (US Sales Only), PC A10/MF A01. File Number TI84780622. (CONF-8311183—).

From 3. Australian conference on nuclear techniques of analysis; Lucas Heights, Australia (1 Nov 1983).

A study is being undertaken of the ion-optics of a 5U Pelletron, used in a proton microprobe. The optics of two components, the electrostatic lens and the accelerator tube are considered.

48376 (SAND—84-1816) **Electron beam propagation along charged foils.** Poukey, J.W.; Freeman, J.R. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1984. Contract AC04-76DP00789. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85002137.

An electrically isolated metal disc or foil is proposed as a method for transporting cylindrically convergent high-power electron beams in vacuum to a central target. Examples of 2-D PIC computations are shown for PBFA-X parameters. The results demonstrate the validity of the basic idea but scattering in the foil or mesh might limit the minimum focal radius for some parameters.

4303 Auxiliaries And Components

REFER ALSO TO CITATION(S) 43030048370, 48375, 48733, 49190, 49260

48377 (BNL—34934) **X-ray filters for synchrotron radiation.** Suortti, P.; Thomlinson, W. (Brookhaven National Lab., Upton, NY (USA)). Jul 1984. Contract AC02-76CH00016. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85001348.

A computer program is developed for calculation of the photon flux and power distributions of a synchrotron radiation beam when various filters are inserted in the beam. The low-energy photons are eliminated by a vertical aperture and a set of foils of pyrolytic graphite, so that Be windows can be placed in a beam line using wiggler radiation. Xe gas is a band-pass filter between 25 keV and 34.5 keV. It reduces the power of the radiation from the superconducting wiggler of the NSLS by a factor of 5 while providing 50% transmission at 33 keV, where the iodine contrast angiography will operate. Other possibilities for band-pass filters are Kr, and Fe, Cu or Ag which can be alloyed to Be in small concentrations. The absorption of power in the filters is calculated, and it is concluded that the heat transfer from the graphite foil is due to blackbody radiation, while the rare gas becomes plasma which radiates mostly ultraviolet light or soft x-rays.

48378 (CONF-840788—2) **ORNL ECR multicharged ion source.** Meyer, F.W. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85001283.

From International conference on the physics of highly ionized atoms; Oxford, UK (2 Jul 1984).

A multicharged ion source based on Electron Cyclotron Resonance (ECR) heating has been designed and built at ORNL. The ECR ion source, which is completely dedicated for atomic physics collision studies, produces higher charge states and higher beam intensities than the present ORNL PIG multicharged ion source, and will thus permit study of collision processes involving ions of higher charge states in experiments requiring higher beam intensities than could be previously obtained in our laboratory. The source has already produced up to fully stripped C and O beams, as well as up to He-like Ar beams. Measurements of the energy spread of ions extracted from the ion source operating in both single-stage and two-stage mode are described. In addition, initial results of total cross section measurements for fully stripped light ions incident on atomic hydrogen in the energy range 0.2 to 10 keV are presented. 13 references, 7 figures, 1 table.

48379 (CONF-8405113—3) **Development of optically pumped polarized jet targets for use in heavy-ion reaction studies.** Bemis, C.E. Jr.; Beene, J.R..; Ford, J.L.C. Jr.; Shapira, D.; Shivakumar, B. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85001863.

From Workshop on polarized targets in storage rings; Argonne, IL, USA (17 May 1984).

The development of a laser optically pumped nuclear spin aligned target of ^{151} ^{153}Eu is outlined. The current status of this project, together with the unique macroscopic heavy-ion reaction physics may be addressed using this target, is given. 14 references.

48380 (INIS-mf—9064, pp 72) **Nuclear physics programme with the proposed 8MV tandem accelerator at Lucas Heights.** Boldeman, J.W. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). 1984. NTIS (US Sales Only), PC A06/MF A01. File Number TI84780621. (CONF-840216—).

From 10. nuclear physics conference; Canberra, Australia (6 Feb 1984).

48381 (INIS-mf—9065, pp 96-101) **CSIRO heavy ion analytical facility.** Sie, S.H. (Commonwealth Scientific and Industrial Research Organization, North Ryde (Australia). Div. of Mineral Physics). Nov 1983. NTIS (US Sales Only), PC A10/MF A01. File Number TI84780622. (CONF-8311183—).

From 3. Australian conference on nuclear techniques of analysis; Lucas Heights, Australia (1 Nov 1983).

Details of CSIRO's recently installed tandem electrostatic accelerator are given. The laboratory is designed to facilitate the application of various ion beam analysis techniques, RBS, PIXE and NRA to problems in energy research and the geosciences. The two stage acceleration involving charge exchange reaction is essential in ultra-sensitive mass spectroscopy, one of the new uses of the accelerator.

48382 (INIS-mf—9065, pp 116-118) **Development of a gas-phase field ionization ion source.** Allan, G.L.; Legge, G.J.F. (Melbourne Univ., Parkville (Australia). School of Physics). Nov 1983. NTIS (US Sales Only), PC A10/MF A01. File Number TI84780622. (CONF-8311183—).

From 3. Australian conference on nuclear techniques of analysis; Lucas Heights, Australia (1 Nov 1983).

A field ionization ion source has been developed to investigate the suitability of using such a source with the Melbourne Proton Microprobe. Operating parameters have been measured, and the source has been found to be brighter than the radiofrequency ion source presently used in the Melbourne 5U Pelletron Accelerator. Improvements to the source geometry to increase the current output are planned.

48383 **(TRI-PP—84-30) TRIUMF KAON factory.** Vogt, E. (British Columbia Univ., Vancouver (Canada). TRIUMF Facility). May 1984. 4p. (CONF-8405193—41). NTIS (US Sales Only), PC A02/MF A01. File Number DE84901557.

From Conference on the intersections between particle and nuclear physics; Steamboat Springs, CO, USA (23 May 1984).

TRIUMF is planning later this year to present a proposal to build a 30 GeV, 100 μA KAON factory as Canada's contribution to the emerging world network of large new facilities for nuclear physics and particle physics. The facility, as described below, would be based on a rapid-cycling synchrotron using as an injector the present 520 MeV TRIUMP H^- sector-focused cyclotron. The matching of a cw cyclotron to a pulsed synchrotron is not without technical interest. The proposed KAON factory would be intended to serve global needs in nuclear and particle physics but would also serve as a home for Canada's substantial present community in intermediate energy physics. The science choice dictating the accelerator parameters have evolved along with the recent parallel discussion in the United States and Europe ever since the first KAON factory workshop of the world community held in Vancouver in 1979. The choices have been strongly influenced by the urgent physics questions now confronting nuclear and particle physics as a consequence of the advent of the Standard Model for quarks and leptons and their interactions. The word KAON in the KAON factory proposal has become and acronym for Kaons, Antinucleons, Other hadrons and Neutrinos. In this paper we discuss the science choices underlying the TRIUMF proposal as well as the accelerator and the Canadian context of the proposal.

48384 **Status report on the Holifield Heavy Ion Research Facility.** Jones, C.M.; Alton, G.D.; Ball, J.B.; Benjamin, J.A.; Biggerstaff, J.A.; Erb, K.A.; Hudson, E.D.; Juras, R.C.; Kloeppel, P.K.; Lord, R.S. (Oak Ridge National Lab., TN (USA)). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **220**: No. 1, 1-9(15 Feb 1984). (CONF-8304105—). Contract W-7405-ENG-26.

From 6. international tandem conference; Chester, UK (16 Apr 1983).

The Holifield Heavy Ion Research Facility has been in routine operation since July, 1982. Beams have been provided using both the tandem accelerator alone and a coupled mode in which the Oak Ridge Isochronous Cyclotron is used as an energy booster for tandem beams. The coupled mode has proved to be especially effective and has allowed us to provide a wide range of energetic beams for scheduled experiments. In this report we will discuss the status of the tandem accelerator and some aspects of our experience with coupled operation.

48385 **Brookhaven double MP facility: Recent developments and plans for the future.** Thieberger, P. (Brookhaven National Lab., Upton, NY (USA). Physics Dept.). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **220**: No. 1, 45-53(15 Feb 1984). (CONF-8304105—). Contract AC02-76CH00016.

From 6. international tandem conference; Chester, UK (16 Apr 1983).

The Brookhaven Tandem Van de Graaff facility consists of two model MP accelerators which have been extensively modified and improved over the years. Recent accelerator developments leading to a maximum terminal voltage of 16.5 MV for one of the machines include an increase of the active length of the acceleration tubes, installation of vacuum pumps at intermediate field-free sections, installation of smooth high voltage terminal shields and the implementation of a system for individual acceleration tube conditioning. A new cylindrical voltage divider resistor shield arrangement has been tested and will be installed. A novel 4-stage mode of operating the tandems provides variable low energy highly charged heavy ions used for atomic physics experiments. This type of operation has been improved by the addition of a removable gridded lens at the exit of the last acceleration tube. Plans for the future include the production of relativistic heavy ions by injecting from the tandems into the AGS 30 GeV proton accelerator at BNL either directly or via a tandem booster cyclotron. For this purpose, a high intensity pulsed beam system was developed and tested.

48386 Argonne inverted sputter source. Yntema, J.L.; Billquist, P.J. (Argonne National Lab., Evanston, IL (USA)). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **220**: No. 1, 107-108(15 Feb 1984). (CONF-8304105—). Contract W-31-109-ENG-38.

From 6. international tandem conference; Chester, UK (16 Apr 1983).

The emmittance of the inverted sputter source with immersion lenses was measured to be about 5 π mm mrad MeVsup(1/2) at the 75% level over a wide range of beam intensities. The use of the source in experiments with radioactive sputter targets and hydrogen loaded targets is described. Self contamination of the source is discussed.

48387 Search for doubly-charged negative ions via accelerator mass spectrometry. Kutschera, W.; Frekers, D.; Pardo, R.; Rehm, K.E.; Smither, R.K.; Yntema, J.L. (Argonne National Lab., Evanston, IL (USA)). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **220**: No. 1, 118-122(15 Feb 1984). (CONF-8304105—). Contract W-31-109-ENG-38.

From 6. international tandem conference; Chester, UK (16 Apr 1983).

The Argonne FN tandem accelerator in conjunction with an Enge split-pole magnetic spectrograph has been used as a highly sensitive mass spectrometer to search for doubly-charged negative ions of ^{11}B, ^{12}C and ^{16}O. No evidence for the formation of these ions in an inverted sputter source and the subsequent acceleration in the tandem has been found. The following limits for the ratio of doubly-charged to singly-charged ions were measured: $^{11}B^{2-}/^{11}B^{-} < 1x10^{-15}$, $^{12}C^{2-}/^{12}C^{-} < 2x10^{-15}$, $^{16}O^{2-}/^{16}O^{-} < 2x10^{-14}$. A relatively abundant formation of the short lived, metastable He^{-} ion in the sputter source has been observed.

4304 Storage Rings

48388 (CEA-CONF—7158) Recent undulator and F.E.L. experiments and prospects at LURE. Ortega, J.M.; Bazin, C.; Bergher, M.; Billardon, M.; Deacon, D.; Elleaume, P.; Jezequel, G.; Velghe, M.; Petroff, Y. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France); Paris-11 Univ., 91 - Orsay (France)). Sep 1983. 7p. (CONF-8309118—11). NTIS (US Sales Only), PC A02/MF A01. File Number DE84751750.

From Topical meeting on free electron generation of extreme ultraviolet coherent radiation; Upton, NY, USA (19 Sep 1983).

We review the recent results obtained at Orsay on the first storage ring Free Electron Laser and on V.U.V. experiments. Some prospects to extend the F.E.L. spectral range toward the V.U.V. region are examined.

44 INSTRUMENTATION

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 44010047502, 47502, 47568, 48658, 48660, 48733, 48794

48389 (AD-A—141539/7) Program PREGA pivotal regression analysis of gamma-ray spectra from NaI(T1) detectors for the ND6620 computer. Final report. Phillips, G.W.; Glagola, B.G. (Naval Research Lab., Washington, DC (USA)). 6 Apr 1984. 192p. (NRL-MR—5275). NTIS, PC A09/MF A01.

Program PREGA was developed at NRL to perform a fast and efficient regression analysis of a gamma ray spectrum from an unknown source, taken with a NaI(T1) detector. The analysis determines the best subset from a library of standard spectra to use in fitting the data. Output at each step includes relative intensities and uncertainties for each standard used in the fit, plus the partial F statistic for significance of each library element. Final output includes an analysis of variance (ANOVA) table, distribution of residuals, location of largest residuals, distribution of runs of consecutive residuals with the same sign, and the location of largest runs. The program was written for the Nuclear Data ND6620 computer and has been transferred to VAX II/780.

48390 (FRNC-TH—1356) Contribution to Diogene detector drift chambers study. Drouet, M. (Paris-11 Univ., 91 - Orsay (France)). Jun 1981. 109p. (In French). NTIS (US Sales Only), PC A06/MF A01. File Number DE84751741.

Diogene detector has been brought into operation at Saclay with the collaboration of Strasbourg CRN and Clermont-Ferrand LPC. The Diogene essential characteristic is its solid angle near four pi, allowing complete exclusive measurements. Diogene characteristics allow to detect an important multiplicity of charged particles in coincidence, to measure their impulse until a transverse impulse around 1 GeV/c, and to identify them by their energy loss measurement. These general characteristics are exposed after some brief recalls on charged particle detection and migration counters. Technical aspects of the prototype are examined. It has been built to test fabrication technology, choice exactness and performance estimation validity. These detector performance estimation calculations that may be waited for in tracks reconstruction, impulse and energy loss resolution are exposed. Before, the electrostatics study for the prototype is reviewed. The temporary balance of already carried out tests is made.

48391 (FRNC-TH—1530) Experimental determination of an ionisation detector for measuring the nuclear lifetime. Tisserant, S. (Paris-7 Univ., 75 (France)). Jun 1982. 15p. (In French). NTIS (US Sales Only), PC A02/MF A01. File Number DE84751761.

The proton or neutron decay signature needs a good measurement of the varied produced particle energy, together with a good identification of them. The lack of experimental data on electron and charged pion of low energy led to experiment two series of tests. This thesis studies precise, from these tests, the performances of the detector that will be installed at Modane. Prototype performances are first studied, concerning the particle energy measurement (electron and charged pions) and their identification. To extrapolate these results to the final detector, simulation programs will be used. The application of such a program to that of the Electron-Gamma-Shower to energies below 500 MeV/c^2 for electromagnetic showers will be verified. For the pions, a simulation program of pion-nucleus interactions at low energy will be checked out from the experimental test data. Scattering effects, charge exchange and absorption are particularly concerned. These simulations reproduce the prototype results; they will be applied to the expected decay modes of the proton and neutron. It will be shown that a fine grain detector shows a comparable sensitivity for every mode without final neutrino. Triggering probability and decay sign probability will be studied particularly.

48392 (INIS-BR—121, pp 129) **Photoacoustic dosimeter.** Mascarenhas, S.; Vargas, H.; Cesar, C.L. (Sao Paulo Univ., Sao Carlos (Brazil). Inst. de Fisica e Quimica). 1983. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. File Number TI84780533. (CONF-8308170—).

From Meeting on medical physics in Rio de Janeiro; Rio de Janeiro, Brazil (25 Aug 1983).

48393 (INIS-BR—121, pp 130) **Efficiency of four dosimetric systems for 2-10 MeV electron beams.** Agostini, A.; Craveiro, P.M.; Cruz, M.T. da; Kalil, C.M.; Martins, H.L. (Beneficiencia Portuguesa, Sao Paulo (Brazil). Servico de Radioterapia). 1983. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. File Number TI84780533. (CONF-8308170—).

From Meeting on medical physics in Rio de Janeiro; Rio de Janeiro, Brazil (25 Aug 1983).

48394 (INIS-BR—121, pp 131) **Use of films in the study of electron beams.** Bruno, S.J.P. (Hospital dos Servidores do Estado, Rio e Janeiro (Brazil)); Pereira, E.N. (Instituto Nacional do Cancer, Rio de Janeiro (Brazil)). 1983. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. File Number TI84780533. (CONF-8308170—).

From Meeting on medical physics in Rio de Janeiro; Rio de Janeiro, Brazil (25 Aug 1983).

48395 (INIS-mf—9064, pp 26) **Assessment of underground gamma ray fluxes at a depth of 1230 metres.** Bakich, A.M.; Omori, M.; Peak, L.S.; Wearne, N.T. (Sydney Univ. (Australia). School of Physics). 1984. NTIS (US Sales Only), PC A06/MF A01. File Number TI84780621. (CONF-840216—).

From 10. nuclear physics conference; Canberra, Australia (6 Feb 1984).

48396 (INIS-mf—9065, pp 108-111) **Development of a thermoelectrically cooled solid state detector probe for on-stream analysis of mineral slurries.** Gardner, K.J.; Chensee, M.D.; Hartley, P.E.; Watt, J.S. (Commonwealth Scientific and Industrial Research Organization, Lucas Heights (Australia). Div. of Mineral Physics). Nov 1983. NTIS (US Sales Only), PC A10/MF A01. File Number TI84780622. (CONF-8311183—).

From 3. Australian conference on nuclear techniques of analysis; Lucas Heights, Australia (1 Nov 1983).

The development of an immersion probe for on-stream analysis of mineral slurries is described. It is based on thermoelectric cooling of the silicon solid state detector, with waste heat mainly from the Peltier cells, dispersed through the walls of the probe to the slurry. The aim is to achieve an X-ray energy resolution of 300 eV at 6 keV for a detector of area >=30 mm^2.

48397 (LBL—17915) **Electromagnetic detector for relic axions.** Morris, D.E. (Lawrence Berkeley Lab., CA (USA)). May 1984. Contract AC03-76SF00098. 24p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85001299.

Axions are particles of small mass postulated to explain CP conservation in strong interactions. The predicted properties of axions provide an explanation for the early clustering of matter into galaxies, the mass in galactic halos, and the missing mass sufficient to close the universe. The interaction of axions with ordinary matter would be extremely weak, but axions should be detectable, because in a strong magnetic field relic axions of mass m/sub a/ would convert into microwave photons with frequency f=m/sub a/c^2/h. Predictions for the frequency range from 3 and 24 GHz for relic axions which provide mass density sufficient to close the universe. We propose a laboratory search for relic axions. A specific experimental apparatus is described and system performance is estimated to illustrate the design principles. The microwave signal from axion conversion is produced in a 30 liter microwave cavity which contains dielectric phase shifting plates to give a quality factor (Q) greater than 10^6, and to provide the correct phasing of the microwave electric field throughout the cavity. The cavity is placed in an 8 Tesla superconducting magnet, and the signal is measured with a conventional microwave receiver employing a GaAs FET rf amplifier or Schottky diode mixer. The cavity, magnet and rf amplifier/mixer will operate at 4°K, with noise temperature between 20°K and 200°K. The system is equally effective in principle at all frequencies between 1 GHz and 100 GHz at which microwave receivers are available. The corresponding range of axion mass which can be covered is $4x10^{-6}$ eV to $4x10^{-4}$ eV. A search can be carried out over an octave of frequency in an observation time of three months with sufficient sensitivity to detect axions if they make up the galactic halo.

48398 (N—84-23866) **Thermal detectors as X-ray spectrometers.** Moseley, S.H.; Mather, J.C.; Mccammon, D. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Apr 1984. 27p. (NASA-TM—86092). NTIS, PC A03/MF A01.

Sensitive thermal detectors should be useful for measuring very small energy pulses, such as those produced by the absorption of X-ray photons. The measurement uncertainty can be very small, making the technique promising for high resolution nondispersive X-ray spectroscopy. The limits to the energy resolution of such thermal detectors are derived and used to find the resolution to be expected for a detector suitable for X-ray spectroscopy in the 100 eV to 10,000 eV range. If there is no noise in the thermalization of the X-ray, resolution better than 1 eV full width at half maximum is possible for detectors operating at 0.1 K. Energy loss in the conversion of the photon energy to heat is a potential problem. The loss mechanisms may include emission of photons or electrons, or the trapping of energy in long lived metastable states. Fluctuations in the phonon spectrum could also limit the resolution if phonon relaxation times are very long. Conceptual solutions are given for each of these possible problems.

48399 (PB—84-200765) **Measurement of the in-situ density of cement-bound materials. Laboratory report.** Sherwood, P.T.; Clark, A.J. (Transport and Road Research Lab., Crowthorne (UK)). 1984. 30p. NTIS, PC E04/MF E04.

This report describes the results of an investigation made to assess the potentialities of nuclear moisture/density gauges for determining the in-situ density of cement-bound bases and sub-bases. The results of field trials showed that density measurements made with nuclear gauges used in the direct transmission mode were at least as accurate as densities determined by the sand replacement test and measurements made on cores cut from the hardened material. Furthermore the speed with which the results were obtained far exceeded those obtained by any other available method.

48400 (SAND—84-1036C) **P-I-N CdTe gamma-ray detectors by liquid phase epitaxy (LPE).** Shin, S.H.; Niizawa, G.T.; Pasko, J.G.; Bostrup, G.L.; Ryan, F.J.; Khoshnevisan, M.; Westmark, C.I.; Fuller, C. (Rockwell International Corp., Thousand Oaks, CA (USA). Science Center; Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 5p. (CONF-841156—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84012276.

From Nuclear science symposium; Orlando, FL, USA (1 Nov 1984).

A new device concept of CdTe gamma ray detectors has been demonstrated by using p+(HgCdTe)-n(CdTe)-n+(HgCdTe) diode structures. Both p+ and n^+-type Hg/sub 0.25/Cd/sub 0.75/Te epilayers were grown by the liquid phase epitaxy (LPE) technique on semi-insulating CdTe sensor elements. The LPE-grown P-I-N structure offers potential advantages for p-n junction formation and ohmic contact over standard ion-implanted diodes or Schottky barrier devices. Detectors with active areas of 2 mm^2 were fabricated. Resolutions of 10 keV were obtained for the 122 keV gamma peak of Co^{57} at room temperature.

48401 **Differential radioactivity monitor for non-invasive detection of ocular melanoma.** Lambrecht, R.M.; Packer, S. (Brookhaven National Laboratory Upton, NY (USA)). pp 2601-2602 of Nuclear medicine and biology. Vol. 3. Proceedings of the congress. Raynaud, C. (ed.). Paris, France; Pergamon Press (1982). (CONF-820804—Vol.3).

From 3. world congress of nuclear medicine and biology; Paris, France (29 Aug 1982).

Published in summary form only.

4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

REFER ALSO TO CITATION(S) 44020048338, 48360

48402 (AD-A—141885/4) **Preparation and characterization of optical waveguides for sensor and communication applications.** (Geo-Centers, Inc., Newton Upper Falls, MA (USA)). Mar 1983. 12p. (GC-TR—83-249). NTIS, PC A02/MF A01.

This technical effort has three basic elements: Study the long term effects of ionizing radiation on fiber optic transmission lines; Develop support hardware for the drawing of experimental fiber optic cables; and Determine specified physical properties of optical fibers, e.g. tensile strength, index profile and optical density.

48403 (AD-A—142448/0) **Proton-induced single event upsets in the SBP9989 microprocessor. Final report.** Myers, L.T.; Shapiro, P.; Petersen, E.L.; Campbell, A.B.; Emily, D. (Naval Research Lab., Washington, DC (USA)). 12 Jun 1984. 28p. (NRL-MR—5213). NTIS, PC A03/MF A01.

This report describes the investigation of proton-induced single event upsets in the SBP9989 micro-processor fabricated by Texas Instruments, Inc. Ten different devices with various date codes were tested. Total dose failure occurred in five of these devices after 10 to the 12th power protons per sq cm. An average upset cross section of 6 times 10 to the minus 12th power upset-sq cm/proton-device was observed. Comparison with cosmic ray-induced upsets indicates that proton-induced upsets represent a more severe problem for satellites with orbits between 600 and 2500 nautical miles.

48404 (EGG-M—05984) **Radiation response of optical fibers in a nuclear reactor.** Partin, J.K. (Idaho National Engineering Lab., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 8p. (CONF-840872—27). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84017221.

From SPIE annual technical symposium; San Diego, CA, USA (19 Aug 1984).

The Idaho National Engineering Laboratory (INEL) is actively involved in the development and application of fiberoptic-based instrumentation for use in nuclear reactor research. To aid in this development effort, a testing program has been undertaken to quantify optical losses in promising waveguide materials during radiation exposure at elevated temperatures characteristic of reactor environments. This paper reports results of testing conducted during the fuel-conditioning phase of the Severe Fuel Damage Test 1-1A performed at the INEL's Power Burst Facility. Radiation-resistant fiberoptic samples were obtained from five manufacturers: the Spectran Corporation, the Quartz Products Corporation, Dainichi-Nippon Cables, Ltd., Fiberguide Industries, and Hughes Research Laboratories. Two identical sets of samples were placed in a specially designed test fixture and positioned approximately 60 centimeters above the reactor core. One was held at a temperature of 200°C, while the second remained at 20°C. The radiation-induced optical attenuation was monitored in several spectral bands in the 600 to 1100 nanometer region. The in situ measurements were recorded over a 125 hour period during which the reactor power varied between 0.1 to 22 MW thermal. The samples were exposed to average fluxes of 2.8 x 10^9 n/cm^2/sec thermal neutrons, 4.4 x 10^8 n/cm^2/sec fast (> 1 MeV) neutrons, and dose rates of approximately 10^6 rad/hr gamma radiation. The growth and recovery of radiation-induced losses as a function of wavelength, temperature, and reactor power level are presented.

48405 (LA-UR—84-1830) **Catastrophic versus microscopic damage: applicability of laboratory measurements to real systems.** Foltyn, S.R.; Jolin, L.J. (Los Alamos National Lab., NM (USA)). Jun 1984. Contract W-7405-ENG-36. 17p. (CONF-841163—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84013896.

From Optical materials for high power lasers meeting; Boulder, CO, USA (14 Nov 1984).

At ultraviolet wavelengths, damage to both coatings and bare surfaces is dominated by the presence of discrete localized defects. During multiple-shot irradition, the overwhelming majority of these defects are damaged by the first or first few shots. Initially, damage morphology is that of a crater of approximately 10 microns in diameter; however, upon continued irradiation, one of two events can occur; either the crater grows to catastrophic dimensions or it remains unchanged. In the latter case, the damage is only observable under a microscope, it may be indistinguishable from cosmetic defects before irradiation, and it is likely that any related degradation in optical performance is unmeasurable. In view of the generally accepted definition of laser damage (i.e. any visible change in the surface), it is important to consider the implications for real systems. These are discussed in the context of ultraviolet test results for both coatings and surfaces.

48406 (SAND—84-0542C) **Transient response of a small-signal microwave GaAs FET to x-rays.** Castle, J.G. Jr.; Armendariz, M.G.; Smith, D.R.; Schuster, G.R. (Sandia National Labs., Albuquerque, NM (USA); Kaman Sciences Corp., Colorado Springs, CO (USA)). 21 Aug 1984. Contract AC04-76DP00789. 9p. (CONF-840712—13). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85000066.

From 21. IEEE annual conference on nuclear and space radiation effects; Colorado Springs, CO, USA (22 Jul 1984).

Microwave power output of a submicron-gate GaAs FET, containing no buffer layer, is observed to recover within one hundred nanoseconds after the x-ray pulse from a FEBETRON 705 source. The FET is formed by implanting ions into the substrate, grown with a liquid encapsulated Czochralski method and doped lightly with chromium. 11 references.

48407 (SAND—84-1187C) **Comparison of ionizing radiation and hot electron effects in MOS structures.** Mikawa, R.E.; Lenahan, P.M. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 10p. (CONF-840712—12). NTIS, PC A02/MF A01; GPO Dep. File Number DE84016766.

From 21. IEEE annual conference on nuclear and space radiation effects; Colorado Springs, CO, USÅ (22 Jul 1984).

We use electron spin resonance to compare the effects of electron injection and gamma radiation on MOS devices. Electron injection is similar to ionizing radiation in that in both cases P/sub b/ centers are generated at the Si/SiO$_2$ interface. However, the effects are not identical; although ionizing radiation creates E′ centers in the SiO$_2$, we are unable to observe any E′ generation in oxides subjected to electron injection.

48408 (UCID—20089) **SAM EMP (SEMP) model.** Thatcher, R.M. (Lawrence Livermore National Lab., CA (USA)). May 1984. Contract W-7405-ENG-48. 67p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85001927.

The Surface-To-Air Missile (SAM) Electro-Magnetic-Pulse (EMP) (SEMP) model simulates the illumination of an entire SAM brigade with an EMP weapon. It computes probability distributions of SAM brigade performance levels after an EMP attack has occurred. Brigade performance is determined by the combination of components that survive the EMP. Accordingly, the SEMP model is separated into the component failure model and the condition model. The component failure model computes the failure probability of each component in the brigade from data supplied by two input data files. The condition model converts component failure probabilities into brigade performance in the form of missile availability probability tables.

48409 (UCID—20135) **Phenomenological investigations in high-altitude EMP (HEMP).** Cabayan, H.S. (ed.). (Lawrence Livermore National Lab., CA (USA)). Jul 1984. Contract W-7405-ENG-48. 194p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85001766.

This report describes the presently available state-of-the-art analysis tools and extensions of these that are applicable to enhancing our understanding of the interaction and coupling phenomena associated with the high-altitude nuclear electromagnetic pulse

(HEMP) and its effects on military systems. Such an in-depth understanding would provide the framework for a more scientific approach to system testing and hardening. In the report, we also briefly review past research programs in this area and evaluate the degree of their success. The emphasis in system assessment tools is placed on a probabilistic failure analysis approach that can provide a framework for vulnerabilities assessment and hardening. In coupling the emphasis is placed on a phenomenological understanding which involves a multifaceted approach involving analytical, computational, and experimental techniques in a complementary way. In component susceptibility, the emphasis is on the development of validated one, two and possibly three dimensional computer models that include the major physical phenomena such as heat and electronic transport equations. A gap exists in being able to express physics quantities in these codes in terms of nonlinear circuit parameters that can be used in the circuit codes.

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 44030047295, 47309, 48336

48410 (DOE/SF/00098—T4) **Formation of the S-1 photocathode. Progress report, September 1-October 31, 1972.** McConaghy, C.; Brown, T.G. (California Univ., Livermore (USA). Lawrence Radiation Lab.). 10 Nov 1972. Contract W-7405-ENG-48. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85001756.

We have successfully made a cathode with a sensitivity of 0.3 mA/W at $\lambda = 1.06\mu$ with the processing method given above. There are a variety of methods for manufacturing Ag-O-Cs photocathodes. We have found the method detailed in Section 3.0 adequate for our needs. We have found that some skill must be acquired in cesiating if this method is to produce high IR sensitive photocathodes. The ability to distinguish thermionic, photo, and leakage currents apart is perhaps the most crucial factor in evolving the stoichiometric amount of cesium. Excess amounts of cesium cannot be tolerated in the Ag-O-Cs structure as they can in the case of some bi-alkalai cathodes.

48411 (INIS-mf—9065, pp 22-24) **Analysis of ion implanted semiconductor materials using a versatile goniometer.** Kenny, M.J.; Scott, M.D. (Commonwealth Scientific and Industrial Research Organization, Lucas Heights (Australia). Div. of Chemical Physics); Janky, S. (Commonwealth Scientific and Industrial Research Organization, Clayton (Australia). Div. of Chemical Physics). Nov 1983. NTIS (US Sales Only), PC A10/MF A01. File Number TI84780622. (CONF-8311183—).

From 3. Australian conference on nuclear techniques of analysis; Lucas Heights, Australia (1 Nov 1983).

A goniometer with three rotational and two translational degrees of freedom has been constructed. It is primarily intended for analysis of ion implant and damage profiles in 50 mm diameter silicon crystal wafers by Rutherford backscattering and channelling.

48412 (INIS-mf—9065, pp 104-106) **Spherical aberration in a proton microprobe.** Jamieson, D.N.; Legge, G.J.F. (Melbourne Univ., Parkville (Australia). School of Physics). Nov 1983. NTIS (US Sales Only), PC A10/MF A01. File Number TI84780622. (CONF-8311183—).

From 3. Australian conference on nuclear techniques of analysis; Lucas Heights, Australia (1 Nov 1983).

The effects of spherical aberration in a protron microprobe are discussed. The size of the abberation is calculated and means of correcting the abberration by octupoles are described.

48413 (LBL-PUB—475) **Electron microscopy users' guide.** (Lawrence Berkeley Lab., CA (USA)). Aug 1984. Contract AC03-76SF00098. 21p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85000386.

Four instruments at the National Center for Electron Microscopy are described and their specifications are listed briefly. User policies, proposal submission and scheduling, accommodations and travel and radiation protection are briefly discussed. (LEW)

48414 (SAND—84-1170C) **Strained-layer superlattice emitter and detector structures using modulation-doped active regions.** Dawson, L.R.; Zipperian, T.E.; Barnes, C.E.; Wiczer, J.J.; Osbourn, G.C. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 7p. (CONF-8409137—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85000064.

From International symposium on GaAs and related compounds; Biarritz, France (26 Sep 1984).

Double-heterostructure p^+n diodes have been fabricated from strained-layer superlattice (SLS) material in which the emitting and absorbing region consisted of alternate 120 A thick layers of GaAs and In$_2$Ga$_8$As. This region was modulation doped by a Si impurity spike in only the central 30 A of the GaAs layers. When operated as detectors (0 volts bias), these structures exhibited internal quantum efficiencies of 75%. As emitters they produced output at 1.02 μm comparable to that of commercially available 1.06 μm devices. Demonstration of efficient emitter/detector operation in modulation-doped SLS materials, in comparison to that of uniformly doped SLS structures and bulk InGaAs commercial devices, while simultaneously optimizing parallel transport properties (horizontal electron mobilities) implies that the InGaAs/GaAs SLS system is an attractive candidate for integrated optoelectronic applications.

48415 (SAND—84-8016) **User's manual: menu-driven data graphing program for the Tektronix 7912AD and 7612D transient digitizer system.** Mitchell, J.L. (Sandia National Labs., Livermore, CA (USA)). Aug 1984. Contract AC04-76DR00789. 87p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85002151.

This manual describes how to use the Explosive Firing Facility's menu-driven data graphing program. Written for a Tektronix general-purpose-interface-bus controlled transient digitizer system, this SPS BASIC program enables the user to graph single-shot data that has been acquired and stored in permanent data files by the Firing Facilities Data Acquisition program. Limited post-shot data analysis, quick-look graphics output, and formatting data output are available. A familiarity with the FFDAP user's manual (SAND84-8002) is required before reading this manual.

48416 (UCRL—90478) **High-speed, eight-frame electro-optic camera with multipulsed ruby laser illuminator.** Shaw, L.L.; Steinmetz, L.L.; Behrendt, W.C.; Sonderman, J.B.; Beer, G.K.; Seppala, L.G.; Romero, E.; Mikkelson, K. (Lawrence Livermore National Lab., CA (USA); Sandia National Labs., Albuquerque, NM (USA)). Sep 1984. Contract W-7405-ENG-48. 8p. (CONF-840887—11). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85001748.

From 16. international congress on high speed photography and photonics; Strasbourg, France (27 Aug 1984).

We have developed a high-speed, electro-optic camera that features a large format; eight frames; and an accompanying eight-pulse, ruby laser illuminator. This system offers greater resolution and versatility than has been previously available. The eight 75-mm frames provide high dynamic spatial resolution (15 line pairs/mm) and time resolution (as short as 10-ns exposure time) to record fine physical details of rapid events. Four independent two-frame (tube) cameras complete with objective optics comprise the eight-frame array. Finally, pulsed ruby laser illumination with spectral filtering allows photography in intense ambient light.

4404 Well Logging Instrumentation

REFER ALSO TO CITATION(S) 44040048782

45 EXPLOSIONS AND EXPLOSIVES

4501 Chemical

48417 (CONF-840734—21) **Mass spectrometry/mass spectrometry as a screening method for detecting explosive vapors.** Glish, G.L.; McLuckey, S.A.; Carter, J.A. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85001276.

From 25. annual meeting of the Institute of Nuclear Materials Management; Columbus, OH, USA (15 Jul 1984).

Mass spectrometry/mass spectrometry (MS/MS) is a relatively new technique for trace analysis. This technique has great potential for the identification of explosive vapors. This paper gives a brief overview of MS/MS with emphasis on the characteristics that make it a likely method for explosive detection. Some preliminary data are presented and a new MS/MS instrument being designed and built for detection of trace explosive vapors is discussed.

48418 (LA-UR—84-2752) **Three-dimensional hydrodynamic hot-spot.** Mader, C.L. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 27p. (CONF-8409128—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE84016821.

From Paul Vieille scientific meeting; Vert-le-Petit, France (26 Sep 1984).

The basic processes in the shock initiation of heterogeneous explosives have been investigated theoretically using a model of a cube of nitromethane containing 91 cubic air holes. The interaction of a shock wave with a single air hole and a matrix of air holes in PETN, HMX, and TATB has been numerically modeled. The interaction of a shock wave with the density discontinuities, the resulting hot-spot formation and interaction, and the buildup to propagating detonation were computed using three-dimensional numerical Eulerian hydrodynamics with Arrhenius chemical reaction and accurate equations of state according to the hydrodynamic hot-spot model. The basic processes in the desensitization of a heterogeneous explosive by preshocking with a shock pressure too low to cause propagating detonation was numerically modeled. The basic differences between shock sensitive explosives such as PETN or HMX and shock insensitive explosives such as TATB or NQ may be described using the hydrodynamic hot-spot model.

48419 (SAND—83-1892C) **CP DDT detonators. I. Design sensitivity study.** Fleming, W.; Fronabarger, J.W.; Lieberman, M.L. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 26p. (CONF-840383—4). NTIS, PC A03/MF A01; GPO Dep. File Number DE84017255.

From 12. symposium on explosives and pyrotechnics; San Diego, CA, USA (13 Mar 1984).

A standard CP detonator design has been used to study a variety of design parameters including test temperature, closure disk thicknes, powder column diameter, transition column diameter, powder column confinement, igniter charge holder material, bridgewire diameter, fire pulse energy, fire pulse duration and fire pulse current. The data indicated a minimum function time for such detonators of approximately 7 μs, which is limited by the deflagration-to-detonation (DDT) process. DDT can be achieved in the presence of some venting but is inhibited by charge holder materials which provide the poor confinement. Increasing the powder column diameter or the transition column diameter results in longer function times. With increasing temperature, output increases and function time decreases.

48420 (SAND—83-1894C) **Analysis of a potential hot-wire ignition problem.** Lieberman, M.L.; Villa, F.J.; North, C.J. (Sandia National Labs., Albuquerque, NM (USA); Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1984. Contract AC04-76DP00789. 18p. (CONF-840383—5). NTIS, PC A02/MF A01; GPO Dep. File Number DE84017254.

From 12. symposium on explosives and pyrotechnics; San Diego, CA, USA (13 Mar 1984).

A potential ignition problem in a hot-wire device was identified from bridgewire resistance measurements. Microscopic evaluation showed bridgewire deformation which led to the proposal of several potential failure modes. Experimental and analytical assessment of the proposed failure modes implied each was unlikely. Processing studies established that reliable ignition was not jeopardized by small process changes. Extensive lot testing verified that reliable ignition was not jeopardized by the bridgewire deformation.

48421 (SAND—84-0260) **CVD boron on calcium chromate powder.** Coonen, R.M. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1984. Contract AC04-76DP00789. 27p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85000214.

This study was an experimental effort to improve the compositional homogeneity of a pyrotechnic mixture of boron and calcium chromate ($CaCrO_4$). Boron was deposited onto calcium chromate powders at 350°C from a diborane and hydrogen gas mixture at a pressure of 40 torr by Chemical Vapor Deposition (CVD). The $B:CaCrO_4$ ratio of the coated powders was analyzed by inductively-coupled plasma spectroscopy and the distribution of the two phases was observed by electron microprobe analysis. The pyrotechnic activity was determined by differential thermal analysis. In addition to varying the composition of the mixture, an attempt was made to vary the boron distribution by coating both sized and unsized $CaCrO_4$ powders. Boron was deposited for 2 h onto sized $CaCrO_4$ powder, which resulted in a higher weight percentage of boron in comparison to the unsized powder. CVD coated $CaCrO_4$ powders began their pyrotechnic activity at an auto ignition temperature that was lower than the auto ignition temperature observed for mechanically blended mixtures. The coating of sized $CaCrO_4$ powder improved the uniformity of boron deposition of $CaCrO_4$, but it also decreased the pyrotechnic activity.

4502 Nuclear

REFER ALSO TO CITATION(S) 45020047831, 48480, 48566

48422 (AD-A—141402/8) **Rain scavenging model for predicting low yield airburst weapon fallout for operational type studies. Master's thesis.** Krieser, C.R. Mar 1984. 81p. (AFIT/GNE/PH—84M-9). NTIS, PC A05/MF A01.

A method was developed that enables a tactical ground commander to predict gamma radiation dose rates and infinite doses produced by the rain scavenging of low-yield nuclear airburst clouds. A ground activity distribution per unit area at time t, A(x,y,t), is computed using a distribution of activity in the cloud per meter of altitude, A(z,t). To find the maximum activity grounded, it is assumed 100 percent of the cloud activity is instantaneously deposited on the ground by the mechanism of rain scavenging. This maximum A(x,y,t) is then converted to a maximum dose rate, D(x,y,t), from which maximum infinite doses are computed. Maximum dose rate and infinite dose curves vs cloud washout time (after cloud stabilization) are presented for 10 weapon yields ranging from 1.0 kiloton to 0.1 kiloton. It is shown that the radiation hazard levels are insignificant tactical threats at times greater than 36 hours after cloud stabilization.

48423 (AD-A—141482/0) **Program to develop and codify urban nuclear weapon effects. Final report September 1982-June 1983.** Northrop, J.A.; Freeman, B.E.; Duff, R.E. (S-Cubed, La Jolla, CA (USA)). 24 Jun 1983. 59p. (SSS-R—83-6228). NTIS, PC A04/MF A01.

A program is developed which, if implemented, would assess those effects of a detonation of a terrorist nuclear weapon located in a highly built-up urban area which are unique to the environment, and consider possible techniques for damage limitation. It is assumed that the weapon is of low-yield, that its hiding place can be located, and that there is sufficient time before its detonation for the application of mitigation techniques. A series of radiation-hydrodynamic, hydrodynamic, radiation transport, and fallout calculations are defined which would provide insight into the modification to classic nuclear phenomenology produced by unique urban hiding locations, possible mitigating of the blast and thermal threats by materials deliberately placed around the weapon, and changes in the propagation of blast, fallout, and thermal radiation due to surrounding buildings. It is anticipated that, were such a theoretical study program to be implemented, it would provide useful guidance to nuclear emergency response planners.

48424 (INIS-mf—9056) **AWRE: Atomic Weapons Research Establishment.** (Central Office of Information, London (UK)). 1983. 41p. NTIS (US Sales Only), PC A03/MF A01. File Number DE84780620.

This reviews the work of AWRE at Aldermaston and Foulness. The main programme is nuclear and is concerned with the design and development of warheads for strategic and tactical nuclear weapons for the British nuclear deterrent, including those for the Royal Navy's missile carrying submarine fleet. The work is described grouped as design physics, development and materials. Services to these groups and to the whole establishment are provided by Engineering, Safety and Administration. The work ranges from long-term fundamental research, the development of technology, design, prototype development to the environmental testing of engineered products. In materials research the emphasis is on plutonium, uranium and beryllium, on high explosives and a wide range of inorganic and organic materials. The physics of the earth's crust is studied to aid detection of underground nuclear explosions. Reactor research facilities include the two reactors, Herald and Viper.

4503 Explosion Detection

REFER ALSO TO CITATION(S) 45030048601

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

5001 Basic Studies

48425 (AD-A—139907/0) **Aerosol growth in a cold environment.** Yen, Y.C. Feb 1984. 30p. (CRREL—84-6). NTIS, PC A03/MF A01.

An expression relating aerosol growth to cold environmental conditions was developed. This was accomplished by solving the diffusion equation with the method of Laplace transformation. The series solution was expressed in terms of the dimensionless parameters K (ratio of vapor density over droplet surface to droplet density), tau (ratio of environmental vapor density at time zero to vapor density over droplet surface), and dimensionless time omega (ratio of product of diffusion coefficient D and time t to square of initial radius of condensation nucleus). To take into account the variation of the vapor density over the surface of an acidic condensation nucleus due to the continuous dilution of the droplet, the solution was obtained by assuming various levels of constant vapor concentration. The final expression (R/R sub o - 1 = 2.4917 x 10 to the minus 18th power) exp(0.0737 theta) (P sub RHS/25) x (100-P sub RHS) tau to the 0.9890 powder) can be used to compute the value of R once the values of initial radius R sub o, relative humdiity P sub RH, percent of relative humidity at the droplet surface P sub RHS, and environmental temperature theta are given.

48426 (N—84-23050) **Kinetic studies of atmospheric reactions of OH radicals.** Poulet, G.; Jourdain, J.L.; Laverdet, G.; Macleod, H.; Lebras, G. (Centre National de la Recherche Scientifique, 45 - Orleans-la-Source (France). Centre de Recherches sur la Chimie de Combustion et des Hautes Temperatures). 1982. 4p. NTIS, PC A02/MF A01.

Kinetic measurements of OH radical reactions in the atmosphere are summarized. Reactions of OH with organic sulfides, nitric acid, and molecular bromine were studied. (ESA)

48427 (N—84-23051) **Kinetics and products of the reaction OH + HNO3.** Lebras, G.; Jourdain, J.L.; Poulet, G. (Centre National de la Recherche Scientifique, 45 - Orleans-la-Source (France). Centre de Recherches sur la Chimie de Combustion et des Hautes Temperatures). 1982. 3p. NTIS, PC A02/MF A01.

The kinetics and products of the OH + HNO3 reaction were studied in a reactor. The rate constant was determined, and a quantitative indentification of the products was established. It is shown that the estimation of lower stratospheric ozone depletion by CFMS is greatly dependent on the reaction channel. (ESA)

48428 **Temperature and concentration measurements in an internal combustion engine using laser Raman spectroscopy.** Santavicca, D.A.; Zur Loye, A. (Princeton Univ., NJ). pp 8 of Thermophysics conference. Montreal, Canada; American Institute of Aeronautics and Astronautics (1983). (CONF-830629—). Contract AC04-81AL16338.

From 18. AIAA thermophysics conference; Montreal, Canada (1 Jun 1983).

Gas temperature and carbon monoxide concentration were measured in an internal combustion engine using laser Raman spectroscopy. The measurements were taken in the center of the clearance volume in the post flame gases at 20, 40, and 80 degrees after top dead center and at equivalence ratios of 1.1, 1.2, and 1.3. The measured CO concentrations were found to increse with equivalence ratio, to decrese during the expansion stroke and to be approximately twenty percent larger than the chemical equilibrium concentrations at the measured temperatures. 7 references.

5002 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 50020047333, 47339, 47340, 47349, 47351, 47352, 47387, 47589, 47924, 47929, 48087, 48484, 48488, 48489, 48505, 48519, 48595

48429 (DOE/ER/60100—3) **Desorption efficiencies of vapor phase polynuclear aromatic compounds on solid adsorbents.** Timmons, K.D.; Karlesky, D.; Johnson, E.; Warner, I.M. 1984. Contract AS05-82ER60100. 27p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85001303.

Polynuclear aromatic compounds (PNAs) in the vapor phase can be collected by adsorption onto solid adsorbents. This paper reports the results of a study using several liquid and gas chromatographic packing materials to determine their applicability for vapor phase sampling of PNAs. The desorption procedure for PNAs from the solid adsorbents involves extraction with non-polar organic solvents. The desorption efficiency for each adsorbent is evaluated using gas chromatography. The combined adsorption/desorption (recovery) efficiency of several adsorbents was evaluated. These adsorbents can be grouped into four classifications: (1) carbon or charcoal, (2) macroreticular resins such as Tenax GC or the XAD-series, (3) adsorbents solids such as silica, alumina, and Florisil, and (4) bonded-phases on silica such as C_{18}. The resin XAD-8 was found to be most suitable for sampling vapor phase PNAs as a result of its high adsorption desorption efficiency and good reproducibility.

48430 (DOE/EV/01199—64) **Study of atmospheric pollution scavenging. Twentieth progress report.** Semonin, R.G. Sep 1984. Contract AC02-76EV01199. 358p. (COO—1199-64). NTIS, PC A16/MF A01; 1; GPO Dep. File Number DE84017449.

A continued search for precipitation chemistry records from the past and their interpretation has failed to uncover a discernible trend toward increasing acidity in the United States. Data show current acidity levels, especially in the Northeast have not significantly changed, except for extreme climatological events, over the past 30 years. The more recent (1978 to present) and continuously collected samples from the MAP3S and NADP/NTN networks reveal great variability in wet acidic deposition but no significant trend over most of the United States. Studies of the apportionment of the ion species among various potential sources show that 4 major factors seem responsible for most of the wet deposition chemistry. These are agricultural practices, soil dust, salt (sea and/

or road), and ions associated with pollutant gaseous precursors. Further, organic weak acids contribute to the overall acidity of samples with wide variations of the weak to strong acid across the United States. The bulk dry deposition from the NADP/NTN network has been analyzed. The distribution of key ions shows a spatial correlation suggesting real information content is contained in the data bank. These data should be more thoroughly researched and the results used to aide the establishment of a dry deposition monitoring network. Finally, the entire available data set was used to characterize the precipitation chemistry of the United States. It was found the 4 ions contribute 90 or more percent of the total ion concentration in the eastern United States. The 4 ions change between stations influenced by the oceans, and those influenced by continental sources. Hydrogen and sulfate are important in all regions while nitrate, ammonium, calcium, sodium, and chloride constitute the remaining 2 ions in specific regions. Proposed emission reduction strategies, if adopted, should significantly alter this characterization.

48431 (DOE/EV/01199—64, pp 7-44) **Acid rain data collection, handling, analysis and interpretation.** Semonin, R.G. Sep 1984. NTIS, PC A16/MF A01. File Number TI84017449. (COO—1199-64).

In Study of atmospheric pollution scavenging. Twentieth progress report.

The complexities of sampling precipitation for chemical analysis are discussed emphasizing topics requiring care and skill to insure high quality data, including; sampling equipment, sample handling, and sample analysis. Brief descriptions are given of the some interpretive analyses using data from the NADP, MAP3S, and CANSAP data bases. The national picture of pH illustrates the spatial variability in the US. The northeast shows the lowest pH values while the Great Plains show the highest. The mountain and intermountain West shows great spatial variability influenced by the orography of the region. The distributions of the total ion concentration, and the chloride, calcium, sulfate, nitrate, and hydrogen ions are also shown and discussed. These distributions are used to characterize the precipitation chemistry over the eastern US using only four ions. The ratios of hydrogen, ammonium, and calcium to the sum of sulfate and nitrate reveal the maximums ($\geqq 0.6$) occur in the northeast, central plains, and intermountain basin, respectively. Finally, a brief account of reinterpreting 1955 to 1956 data suggest that the trend toward increasing and spreading acidity in the northeast may not be as alarming as previously considered. 28 figures.

48432 (DOE/EV/01199—64, pp 75-84) **Regional characterization of rain acidity utilizing Gran's plot titrations.** Peden, M.E.; Lockard, J.M. Sep 1984. NTIS, PC A16/MF A01. File Number TI84017449.

In Study of atmospheric pollution scavenging. Twentieth progress report.

The pH of precipitation is a measure of free acidity. This acidity can be influenced by factors other than strong mineral acids, including basic cations and weak acids. To investigate the relationships affecting the free and total acidities at various locations throughout the US, acidity titrations were performed on selected samples from four National Atmospheric Deposition Program (NADP) collection sites. The data presented have quantitatively characterized the precipitation by combining information obtained from routine anion and cation analyses with data derived from total acidity titrations. Similarities are apparent between the two sites located east of the Mississippi River and the two western collection sites. The ratios of strong to weak acids decrease from east to west as a result of both decreased strong acidities and increased ammonium concentrations. No evidence of a significant contribution of organic acids was found in samples from any of these sites, presumably due to the time lag between collection and analysis. Data on the potental contributions of the organic acids to both the free and total acidities at these sites are still needed to completely characterize the acidity relationships presented here. 3 references, 3 figures, 1 table.

48433 (DOE/EV/01199—64, pp 85-136) **Chemistry and meteorology of extreme pH departures in precipitation on the regional scale.** Doty, K.G.; Semonin, R.G. Sep 1984. NTIS, PC A16/MF A01. File Number TI84017449.

In Study of atmospheric pollution scavenging. Twentieth progress report.

In the statistical analysis of the seasonal distributions of several ions, the results showed that the H^+ and SO_4^{2-} ions were the most variable and the Na^+ and NO_3^- ions were the least variable. The H^+ and SO_4^{2-} ion patterns were very similar except for the winter-spring comparison, where 11 sites showed differences for SO_4^{2-} but only three sites showed differences for H^+. This emphasizes the fact that to predict seasonal changes in precipitation acidity one must consider the total cation-anion balance and not the typical acidic source related ions of SO_4^{2-} and NO_3^- alone. Few seasonal differences were observed for the Cl^-, NH_4^+, Ca^{2+}, Mg^{2+}, and K^+ ions for the spring through fall period. High concentrations of Ca^{2+}, Mg^{2+}, and K^+ during the period of 17 to 24 March 1981 across the test area occurred in conjunction with weekly precipitation amounts generally less than .25 inches accompanied by high winds over dry land surfaces with little extensive snow cover. Trajectory analyses for 3 to 4 April 1981 provided evidence for the potential transport of dust storm aerosol from the southern plains and incorporation with precipitation for NE15, sites in southern Illinois, and possibly sites in Ohio. The acidic departure case study period of 21 to 28 July 1981 revealed high concentrations of most ions in comparison with adjacent weeks, and appeared to be related with the smaller average sample volume across the test domain and the relatively long dry period before the main rainfall event. 19 references, 33 figures, 4 tables.

48434 (DOE/EV/01199—64, pp 137-150) **Dry bucket analysis of the NADP network.** Semonin, R.G. Sep 1984. NTIS, PC A16/MF A01. File Number TI84017449.

In Study of atmospheric pollution scavenging. Twentieth progress report.

The purpose of this study was to determine whether some information is contained in the dry bucket samples acquired from an AeroChem Metrics wet-dry sampler. It is contended that the data shown are consistent and not random excursions, and may, in fact, represent some portion of dry deposition for those ions discussed. It should be emphasized that dry deposition has different meanings to different investigators and to the national program. The definition of dry deposition itself needs to be clarified to provide a common foundation for future research endeavors. For example, the dry deposition of sulphur dioxide on a surface of vegetation is largely determined not by atmospheric forces distributing the gas, but rather upon the biological structure of the impinged material. Certain vegetation openly accepts sulphur dioxide through the stomata of the plants whereas others resist gaseous uptake at the same concentration. However, the dry deposition of aerosol is largely determined by mechanical factors in the atmosphere and by the collecting surface. In this case no particular biolgical effect is responsible, but rather the mechanical attachment of an aerosol particle to whatever collecting surface is impacted. Thus the data presented in Figures 1 to 9 are likely a realistic assessment of dry deposition to an exposed polyethylene bucket. If one wanted to use these values to estimate the dry deposition to a forest or to a flat grassland or to some other surface, one would have to do research to compare the deposition in a bucket to the particular surface of interest. 9 figures.

48435 (DOE/EV/01199—64, pp 151-170) **Metal solubility in atmospheric deposition.** Gatz, D.F.; Chu, L.C. Sep 1984. NTIS, PC A16/MF A01. File Number TI84017449.

In Study of atmospheric pollution scavenging. Twentieth progress report.

Both soluble and insoluble metals were measured in weekly wet, dry, and bulk precipitation samples collected in suburban Chicago during 59 sampling periods from December, 1979, to March, 1981. Distributions of percent soluble metals show differences in solubility between metals, $Zn = Cd > Cu > Pb$, and differences for all metals between sample types, wet > bulk = dry. Metal solubility in precipitation is similar to that of other natural waters with respect to the effects of pH and insoluble materials. Solubility decreases as pH and the concentrations of total mass and insoluble Fe increase. Thus, metals are less soluble in dry and bulk samples than in wet-only samples because dry and bulk samples contain more insoluble matter. Only a weak relationship was found between concentrations of insoluble Al (as an index of clay mineral concentrations) and soluble fractions of Zn and Pb. These results have important implications for precipitation sampling and sample preparation methodology, as well as for the understanding of metal chemistry in precipitation, airborne metals scavenging processes, metals as tracers for sources of acidity, and effects of acid precipitation on ecosystems. 33 references, 6 figures, 4 tables.

48436 (DOE/EV/01199—64, pp 171-192) **Source apportionment of rain water impurities in central Illinois.** Gatz, D.F. Sep 1984. NTIS, PC A16/MF A01. File Number TI84017449.

In Study of atmospheric pollution scavenging. Twentieth progress report.

The identity and relative contributions of various sources of impurities in precipitation are needed to understand the acidic precipitation phenomenon. This paper reports results of using factor analysis and a chemical element balance (CEB) to apportion sources of impurities in a series of 191 wet-only event precipitation samples collected near Champaign, IL. Factor analysis showed that four major groups of constituents accounted for 86% of the variance in the data: crustal dust, pollutants with gaseous precursors, sea salt, and possibly strong acids. Apportionment of plausible sources by CEB yielded estimates of a 2% contribution of sea salt to the total mass of impurities, a 32% contribution by ammonium and sulfates (including sulfur acid), and a 16% contribution from nitrates. Calculated results were more sensitive to spatial variations in crustal source composition than to differences in composition between bulk materials and source aerosols. Without taking account of insoluble materials, the probable contributions of soil dust and road dust were 7% and 12%, respectively, with outside limits of 3 to 8% and 8 to 24%, respectively. A reasonable assumption regarding Ca and K solubility increased the likely soil contribution from 7% to 15%, but had little effect on the road dust contribution. The use of extracted source material compositions as input to the CEB analyses to compensate for analysis of only the soluble portion of the precipitation samples was not successful. 44 references, 7 tables.

48437 (DOE/EV/01199—64, pp 193-218) **Few preliminary precipitation chemistry statistics.** Semonin, R.G. Sep 1984. NTIS, PC A16/MF A01. File Number TI84017449.

In Study of atmospheric pollution scavenging. Twentieth progress report.

This preliminary statistical analysis of the relationships between the primary ions found in precipitation suggests some of the possible combinations of ions originally present in the atmosphere and subsequently scavenged by the precipitation. As can be noted in a cursory examination of the figures, the area of the United States encompassed within a correlation coefficient of 0.7 or greater is largest for those ion pairs that are commonly associated with natural sources. An example of this is Figure 3 showing the distribution of correlation coefficients between sodium and chloride. As the correlation distributions of ion pairs are examined, progressing from assumed natural resources toward those assumed to be primarily of anthropogenic source, the area of correlation $\geqq$ 0.7 decreased. In particular, viewing the acids that are of concern in the National Acid Precipitation Assessment Program, high correlations between hydrogen ion and chloride, nitrate, and sulfate encompass only a small area confined to the eastern United States. While the area of the $\geqq$ 0.7 correlation between hydrogen and sulfate can be loosely tied to emissions from the industrialized Northeast, the extension of this high correlation toward Mississippi seems to also suggest a parallelism with the forested areas of the Appalachians as well. 17 figures, 1 table.

48438 (DOE/EV/01199—64, pp 219-224) **Results of the World Meteorological Organization (WMO) interlaboratory comparison of reference precipitation samples.** Peden, M.E. Sep 1984. NTIS, PC A16/MF A01. File Number TI84017449.

In Study of atmospheric pollution scavenging. Twentieth progress report.

The system described has proven to be an accurate and efficient method of data acquisition and reduction for ion chromatographic determinations of anions in precipitation samples. The software is easily adaptable to cationic as well as organic acid determinations. Errors inherent in manual transcription and data reduction procedures have been eliminated as a result of the implementation of this microcomputer based system. In addition, analyst time devoted to data reduction tasks has been reduced by an estimated 25%. The cost of the computer hardware and software necessary for this system totalled less than $3000, making it a cost effective addition to the atmospheric chemistry laboratory facility. 1 reference, 2 tables.

48439 (DOE/EV/01199—64, pp 233-250) **Determination of organic acids in Bondville, Illinois precipitation samples by ion chromatography exclusion (ICE).** Bachman, S.R.; Lockard, J.M.; Peden, M.E. Sep 1984. NTIS, PC A16/MF A01. File Number TI84017449. (COO—1199-64).

In Study of atmospheric pollution scavenging. Twentieth progress report.

The importance of weak acid contributions to the rain chemistry of central Illinois was investigated. Precipitation event samples were primarily analyzed for organic acid ions of citrate, formate and acetate using ion chromatography exclusion. The presence of these acids were confirmed and their effect on free acidity of rain samples determined. 5 references, 12 figures, 2 tables.

48440 (DOE/EV/01199—64, pp 277-316) **Precipitation, chemical depositions and water resource issues.** Semonin, R.G. Sep 1984. NTIS, PC A16/MF A01. File Number TI84017449.

In Study of atmospheric pollution scavenging. Twentieth progress report.

The chemical quality of precipitation is related to many different compounds found in nature and produced by man's activities. To understand acidic deposition and its response to nature and man, all chemical constituents in monitoring and research efforts must be included. The uncertainty surrounding quantification of natural sources and the non-acid industrial emissions, their transformation rates in the atmosphere, and their ultimate deposition by precipitation precludes a simple one-to-one relationship between emissions and acidic deposition. A great deal of the scientific uncertainty surrounding this issue is whether or not the chemical quality of precipitation is degrading with time and spreading over a larger area. Neither of these questions can be answered affirmatively. Monitoring of precipitation chemistry is essential to determine the trend of acidic precipitation. Since ecosystem processes respond relatively slowly to gradual environmental changes, including the continued effects of man through land use manage, long-term research and monitoring of such systems is essential. It should be clear that assessment of the benefits should be measured if any regulations are invoked. We should no longer impose environmental regulations without evaluation of their effectiveness in ameliorating the original problem. The United States has embarked on a path of critical research in all of the important scientific areas mentioned. Within 10 years many answers will be available. 8 references, 22 figures.

48441 (DOE/EV/01199—64, pp 317-338) **Review of particle tracers of atmospheric processes.** Gatz, D.F. Sep 1984. NTIS, PC A16/MF A01. File Number TI84017449.

In Study of atmospheric pollution scavenging. Twentieth progress report.

This review is limited to particle tracers deliberately released for use in investigations of atmospheric processes, including transport, dispersion, wet and dry deposition, resuspension, and others. Particle tracers have been used in atmospheric research since the early 1950's. Their use is currently declining in favor of gaseous tracers useful over longer distances. Publications reporting applications to transport and dispersion peaked in the late 1960's, those giving results of precipitation scavenging and wet deposition experiments peaked in the early 1970's, and those devoted to dry deposition and resuspension peaked in the late 1970's and early 1980's. Many different materials have been used as tracers. The materials generally fall into one of four groups: pollen and spores, organic materials, inorganic materials, and radioisotopes. This review describes the individual materials used as particle tracers, and also the methods used to generate an aerosol of them, to sample them, and to analyze for them. A bibliography of over 100 papers is included. 115 references, 1 figure, 5 tables.

48442 (DOE/EV/01199—64, pp 339-358) **Tracer applications for the study of precipitation processes.** Semonin, R.G. Sep 1984. NTIS, PC A16/MF A01. File Number TI84017449.

In Study of atmospheric pollution scavenging. Twentieth progress report.

The use of tracers to improve our knowledge of precipitation processes was discussed. Major gaps in our knowledge were identified and research areas were suggested. Suggested research included: quantify source apportionment between evaporation from water and transpiration from land; quantify source differences between natural and anthropogenic; ascertain the chemical evolution of nuclei from source to deposition; quantify nucleating efficiency of aging aerosol; and determine the filter efficiency of cloudy air for particles and gases. A note of caution was expressed in using tracers as tracers may influence cloud microphysics and in turn cloud dynamics. 13 references, 8 figures.

48443 (DOE/EV/01199—64, pp 225-232) **Microcomputer based data acquisition and reduction system for ion chromatography.** Bachman, S.R.; Stahlhut, R.K. Sep 1984. NTIS, PC A16/MF A01. File Number TI84017449.

In Study of atmospheric pollution scavenging. Twentieth progress report.

The system described has proven to be an accurate and efficient method of data acquisition and reduction for ion chromatographic determinations of anions in precipitation samples. The software is easily adaptable to cationic as well as organic acid determinations. Errors inherent in manual transcription and data reduction procedures have been eliminated as a result of the implementation of this microcomputer based system. In addition, analyst time devoted to data reduction tasks has been reduced by an estimated 25%. The cost of the computer hardware and software necessary for this system totalled less than $3000, making it a cost effective addition to the atmospheric chemistry laboratory facility. 3 figures, 2 tables.

48444 **(DOE/NBB—0063) Historical carbon dioxide: abundances derived from the Smithsonian spectrobolograms.** Stokes, G.M.; Barnard, J.C.; Pearson, E.W. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1984. Contract AC06-76RL01830. 121p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE84016740.

The analysis of spectroscopic records offers a method for measuring the concentration of atmospheric carbon dioxide. In view of the sparseness and questionable accuracy of the records of CO_2 concentration prior to 1957 an effort has been initiated to use archived spectroscopic measurements of the sun an a source of such data. The largest and most significant collection of such spectra was generated during the course of a program to measure the solar constant, supported by the Smithsonian Astrophysical Observatory. This program ran from approximately 1920 to 1958, resulting in the generation of a nearly daily record of the solar and telluric spectrum. A representative sample of Smithsonian spectrobolograms have been analyzed for 1935, 1941, and 1948. The resulting carbon dioxide concentrations for those years are 297.7 +- 5.6, 298.4 +- 6.3, and 308.3 +- 4.6 ppM, respectively. There may be an additional 2 to 3 ppM systematic error in this result because of remaining uncertainties in absolute band strengths and the precise relationship between intergrated column density and surface density measurements. These results also yield an annual increase of 0.59 +- .27 ppM for the average trend for the period of 1935 through 1948. The method of analysis used to obtain these results is described in detail. It appears to be much less sensitive to the sources of error that have plagued earlier analyses of the same data. The results also offer obvious guidance as to steps that may be taken to improve the analysis of the data. 43 references, 24 figures, 10 tables.

48445 **(FWS/OBS—80/40.10) Air pollution and Acid Rain, Report 10. The effects of air pollution and acid rain on fish, wildlife, and their habitats: urban ecosystems.** Peterson, M.A. Jun 1982. 97p. NTIS, PC A05/MF A01. File Number TI84901672.

Report 10 of the series synthesizing the results of scientific research related to the effects of air pollution and acid depositon on fish and wildlife resources deals with the urban ecosystem. General aspects of urban ecosystem relevant to a discussion of air pollution effects are presented with an outline of various other types of ecosystem stresses. This report describes plant, animal, and ecosystem responses to air pollution within the following pollutant categories: photochemical oxidates, atmospheric metals, acidifying air pollutants and miscellaneous urban air pollutants. The potential use of biological indicators in monitering ambient urban air pollution is introduced. 206 references, 8 figures, 19 tables.

48446 **(N—84-24019) Parametrization of the turbulent diffusion in the atmosphere using the turbulent energy equation(s).** Lautenschlager, M. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Physik). 1983. 111p. (GKSS—83-E-60). NTIS, PC A06/MF A01.

The turbulent diffusion of pollutants was studied. The turbulent diffusion is represented by the turbulent kinetic energy and a turbulent time scale. The horizontal and vertical turbulent exchange coefficients are determined. The turbulent energies are calculated by partial differential equations. The Crank-Nicolson method is used for time integration. The turbulent time scales are determined by fitting the results of propagation experiments. (ESA)

48447 **(ORNL/TM—9350) Carbon Dioxide Information Center (CDIC). Progress report, January 1982-September 1983.** Maskewitz, B.F.; Watts, J.A.; Weisbin, C.R.; Allison, L.J.; Jacobs, B.F.; Pfuderer, H.A. (Oak Ridge National Lab., TN (USA)). Oct 1984. Contract AC05-84OR21400. 88p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85001934.

The Carbon Dioxide Research Division (CDRD) of the Department of Energy's (DOE) Office of Basic Energy Sciences established a Carbon Dioxide Information Center (CDIC) at the Oak Ridge National Laboratory (ORNL) in January 1982 to support the nation's carbon dioxide-climate research effort by providing a focal point for the compilation and distribution of CO_2-related information under systematic quality control. This informal report documents the establishment and experience of the center during the period January 1, 1982 to September 30, 1983. Progress on the activities and accomplishments by the center are discussed using specific examples to illustrate the concept and development of a specialized information analysis center.

48448 **(PB—84-184753) Development of the MESOPUFF II dispersion model. Final report.** Scire, J.S.; Lurmann, F.W.; Bass, A.; Hanna, S.R. (Environmental Research and Technology, Inc., Concord, MA (USA)). Apr 1984. 92p. NTIS, PC A05/MF A01.

The development of the MESOPUFF II regional-scale air quality model is described. MESOPUFF II is a Lagrangian variable-trajectory puff superposition model suitable for modeling the transport, diffusion and removal of air pollutants from multiple point and area sources at transport distances beyond the range of conventional straight-line Gaussian plume models. It is an extensively modified version of the MESOscale PUFF (MESOPUFF) model. Major additions and enhancements include: use of hourly surface meteorological data and twice-daily rawinsonde data; separate wind fields to represent flow within and above the boundary layer; parameterization of vertical dispersion in terms of micrometeorological turbulence variables; parameterization of SO2 to SO4(-2) and NOx to NO3(-1) conversion, including the chemical equilibrium of the HNO3/NH3/NH4NO3 system; resistance modeling of dry deposition, including options for source or surface depletion; time- and space-varying wet removal; and a computationally efficient puff sampling function. The scientific and operational bases for these developments are described. The results of a preliminary evaluation of several model algorithms during a two-day period of the Tennessee Plume Study are also presented.

48449 **(PB—84-189943) Methodology for development of an independent combustion source NOx inventory and its application to 150 counties in the northeastern United States. Final report December 1981-August 1983.** Apr 1984. 223p. NTIS, PC A10/MF A01.

Prepared in cooperation with Spaite (Paul W.) Co., Cincinnati, OH.

The report gives results of the demonstration of a new methodology for developing a combustion source fuel use and emissions inventory. The demonstration area encompassed 150 counties within a 200 mi (320-km) radius of the Adirondack Mountains in New York State, believed to be representative of the Northeastern U.S. A complete combustion inventory of nitrogen oxides (NOx) emissions was developed for the 150 counties. All sectors (residential, commercial, transportation, utility, and industrial) were included. In the industrial sector, the methodology entailed: (1) identifying all major combustion processes and associated equipment, and (2) developing NOx emission factors. This approach produced a list of 28 facilities and 73 processes, believed to include all significant combustion sources in the 150-county area. An approach was also developed for treating all fuel consumption not accounted for by installations that include major combustion processes. The latter block of fuel consumption was translated into 'residual' industrial area source NOx emissions. As intended, the project demonstrated fully the essential elements of a methodology that would allow development of a county-by-county NOx inventory for all fuel burning in all or any part of the U.S., without resorting to user surveys or inventories based on such surveys.

48450 **(PB—84-194083) Sampling approaches for measuring emission rates from hazardous waste disposal facilities.** Balfour, W.D.; Schmidt, C.E. (Radian Corp., Austin, TX (USA)). May 1984. 19p. NTIS, PC A02/MF A01.

Fugitive air emission data have been collected for treatment, storage, and disposal operations to support a Regulatory Impact Analysis (RIA) for Hazardous Waste Disposal Facilities. Five sampling approaches have been used for measuring air emission rates from these operations. They are: (1) emission isolation flux chamber, (2) vent sampling, (3) concentration-profile technique, (4) transect technique, and (5) mass balance. Each of these techniques are compared as to their precision, potential applications, and specific limitations of the approaches. Data are presented from sites at which the approaches were applied. Results are compared and contrasted where different techniques are compared as to their precision, potential applications, and specific limitations of the approaches. Data are presented from sites at which the approaches were applied. Results are compared and contrasted where different techniques were used to measure emission rates at the same operation. Finally, recommendations are made for selection of an appropriate sampling approach based on the field experience gained.

48451 **(PB—84-199710) Performance evaluation of a real-time aerosol monitor. Information circular/1984.** Williams, K.L.; Timko, R.J. 1984. 27p. (BM-IC—8968). NTIS, PC A03/MF A01.

The Bureau of Mines laboratory tested the response of a commercially available real-time aerosol monitor (GCA RAM-1) to various dusts. Monitor measurements were recorded, averaged, and compared with simultaneous gravimetric measurements of each test dust. Tests usually lasted several hours. The test dusts of various particle size distributions used included coal, limestone, and a commercially available test dust. For each particular dust, the monitor response was linear and correlated well with mass concentration over the range of about 0.5 to 10 mg/cu m. The average monitor response to a mass concentration of coal dust was approximately twice the average monitor response to the same mass concentration of limestone dust.

48452 **(PB—84-200872) Wastes from manufacture of dyes and pigments: Volume 1. Azo dyes and pigments (benzidine and its congeners subsector).** Bomberger, D.C.; Boughton, R.L. (SRI International, Menlo Park, CA (USA)). Jun 1984. 94p. NTIS, PC A05/MF A01.

See also Volume 2, PB84-200880.

In a study of the manufacture of dyes and pigments based on benzidine and its congeners, several solid waste streams that could contain hazardous material were identified. The solid residues included filter cake from clarifying operations, intermediates on discarded shipping containers, and fines collected in bag houses used in grinding and drying operations. An aqueous waste stream containing process wastewater and mother liquor that could contain hazardous material was also identified. Pigment manufacture represented the most important source of wastes because of its large volume relative to dyes. The emissions estimates showed 3,3'-dichlorobenzidine, o-dianisidine, and benzidine, were among the ten materials estimated to represent the major organic emissions from dye and pigment manufacture.

48453 **(PB—84-200880) Wastes from manufacture of dyes and pigments. Volume 2. Azo dyes and pigments (excluding benzidine and its congeners).** Bomberger, D.C.; Boughton, R.L. (SRI International, Menlo Park, CA (USA)). Jun 1984. 215p. NTIS, PC A10/MF A01.

See also Volume 3, PB84-200898, and Volume 1, PB84-200872.

In a study of the manufacture of azo dyes and pigments, several solid wastes that could contain hazardous material were identified. These solid wastes included filter cake from clarifying operations, wastewater treatment solids, intermediates on discarded shipping containers, and fines collected in baghouses used in grinding and drying operations. An aqueous waste stream containing process wastewater and mother liquor that could contain hazardous material was also identified. The major components in the solid and liquid streams were identified, and the amounts produced were estimated. These estimates were made on an individual dye basis and summarized on an industry-wide basis. The major potential discharges of dye, unreacted intermediates, and reaction by-products were in the mother liquor after dye or pigment transferred to wastewater treatment solids. Other major sources of solid residues included dye and pigments on baghouses fines, intermediate in discharged shipping containers, and filter cake solids.

48454 **(PB—84-200898) Wastes from manufacture of dyes and pigments. Volume 3. Stilbene dyes and fluorescent brightening agents.** Gwinn, J.E.; Bomberger, D.C. (SRI International, Menlo Park, CA (USA)). Jun 1984. 34p. NTIS, PC A03/MF A01.

See also Volume 2, PB84-200880, and Volume 4, PB84-200906.

A preliminary study of the manufacture of Stilbene dyes and fluorescent brightening agents was conducted to determine if process waste streams might contain hazardous material. The study first identifies the dyes and pigments that belong to this segment of the industry, the amounts produced and the known U.S. producers. The chemistry of these dyes and pigments is discussed as well as the overall production process and waste treatment practices. Several waste streams that could contain hazardous material are identified and five companies that produce representative dyes and pigments are recommended for a sampling program to confirm the composition and amounts of these waste streams.

48455 **(PB—84-200906) Wastes from manufacture of dyes and pigments. Volume 4. Anthraquinone dyes and pigments.** Gwinn, J.E.; Bomberger, D.C. (SRI International, Menlo Park, CA (USA)). Jun 1984. 85p. NTIS, PC A05/MF A01.

See also Volume 3, PB84-200898, and Volume 5, PB84-200914.

A preliminary study of the manufacture of Anthraquinone dyes and pigments was conducted to determine if process waste streams might contain hazardous material. The study first identifies the dyes and pigments that belong to this segment of the industry, the amounts produced and the known U.S. producers. The chemistry of these dyes and pigments is discussed as well as the overall production process and waste treatment practices. Several waste streams that could contain hazardous material are identified and seven companies that produce representative dyes and pigments are recommended for a sampling program to confirm the composition and amounts of these waste streams.

48456 **(PB—84-200914) Wastes from manufacture of dyes and pigments. Volume 5. Diphenylmethane and triarylmethane dyes and pigments.** Gwinn, J.E.; Bomberger, D.C. (SRI International, Menlo Park, CA (USA)). Jun 1984. 47p. NTIS, PC A03/MF A01.

See also Volume 4, PB84-200906, and Volume 6, PB84-200922.

A preliminary study of the manufacture of diphenylmethane and triarylmethane dyes was conducted to determine if process waste streams might contain hazardous material. The study first identifies the dyes and pigments that belong to this segment of the industry, the amounts produced and the known U.S. producers. The chemistry of these dyes and pigments is discussed as well as the overall production process and waste treatment practices. Several waste streams that could contain hazardous material are identified and five companies that produce representative dyes and pigments are recommended for a sampling program to confirm the composition and amounts of these waste streams.

48457 **(PB—84-200922) Wastes from manufacture of dyes and pigments. Volume 6. Methine and polymethine dyes and pigments.** Gwinn, J.E.; Bomberger, D.C. (SRI International, Menlo Park, CA (USA)). Jun 1984. 41p. NTIS, PC A03/MF A01.

See also Volume 5, PB84-200914, and Volume 7, PB84-200930.

A preliminary study of the manufacture of methine and polymethine dyes and pigments was conducted to determine if process waste streams might contain hazardous material. The study first identifies the dyes and pigments that belong to this segment of the industry, the amounts produced, and the known U.S. producers. The chemistry of these dyes and pigments is discussed as well as the overall production process and waste treatment practices. Several waste streams that could contain hazardous material are identified and four companies that produce representative dyes and pigments are recommended for a sampling program to confirm the composition and amounts of these waste streams.

48458 **(PB—84-200930) Wastes from manufacture of dyes and pigments. Volume 7. Xanthene dyes and pigments.** Bomberger, D.C.; Boughton, R.L. (SRI International, Menlo Park, CA (USA)). Jun 1984. 36p. NTIS, PC A03/MF A01.

See also Volume 6, PB84-200922, and Volume 8, PB84-200948.

A preliminary study of the manufacture of Xanthene dyes was conducted to determine if process waste streams might contain hazardous material. The study first identifies the dyes and pigments that belong to this segment of the industry, the amounts produced and the known U.S. producers. The chemistry of these dyes and pigments is discussed as well as the overall production process and waste treatment practices. Several waste streams that could contain hazardous material are identified and three companies that produce representative dyes and pigments are recommended for a sampling program to confirm the composition and amounts of these waste streams.

48459 **(PB—84-200948) Wastes from manufacture of dyes and pigments. Volume 8. Phthalocyanine dyes and pigments.** Bomberger, D.C. (SRI International, Menlo Park, CA (USA)). Jun 1984. 36p. NTIS, PC A03/MF A01.

See also Volume 7, PB84-200930, and Volume 9, PB84-200955.

A preliminary study of the manufacture of phthalocyanine dyes and pigments was conducted to determine if process waste streams might contain hazardous material. The study first identifies the dyes and pigments that belong to this segment of the industry, the amounts produced, and the known U.S. producers. The chemistry of these dyes and pigments is discussed as well as the overall production process and waste treatment practices. Several waste streams that could contain hazardous material are identified and six companies that produce representative dyes and pigments are recommended for a sampling program to confirm the composition and amounts of these waste streams.

48460 **(PB—84-200955) Wastes from manufacture of dyes and pigments. Volume 9. Sulfur dyes.** Gwinn, J.E.; Bomberger, D.C. (SRI International, Menlo Park, CA (USA)). Jun 1984. 34p. NTIS, PC A03/MF A01.

See also Volume 8, PB84-200948.

A preliminary study of the manufacture of sulfur dyes was conducted to determine if process waste streams might contain hazardous material. The study first identifies the dyes and pigments that belong to this segment of the industry, the amounts produced, and the known U.S. producers. The chemistry of these dyes is discussed as well as the overall production process and waste treatment practices. Several waste streams that could contain hazardous material are identified and two companies that produce representative dyes are recommended for a sampling program to confirm the composition and amounts of these waste streams.

48461 **(PB—84-201524) Interim report on the design and development of a sampling and analytical procedure for the determination of low volatility carbonaceous material in flue gases.** Woodfield, M.J.; Bushby, B. (Warren Spring Lab., Stevenage (UK)). 1984. 37p. (LR—484(AP)-M). NTIS, PC E04/MF E04.

Refuse derived fuel is becoming an important source of energy but more comprehensive data are required in order to assess its organic emissions and compare them with those of other fuels. Work has been carried out at Warren Spring Laboratory to identify the basic requirements of a sampling and analytical system necessary to provide the appropriate data. A preliminary specification has been defined, based on these requirements, and work has been carried out to implement it. This interim report describes the work to date, outlines the design, development and testing of equipment for the sampling of high volatility organic compounds in flue gas, and describes work carried out to develop suitable analytical methods to assess complex organic mixtures.

48462 **(PB—84-201573) Field experience in sampling hazardous waste incinerators.** Gorman, P.; Bergman, F.; Oberacker, D. (Midwest Research Inst., Kansas City, MO (USA)). Jun 1984. 23p. NTIS, PC A02/MF A01.

This paper is for presentation at the 77th annual meeting of the Air Pollution Control Association, June 24-29, 1984. The paper contains much useful, pragmatic information gained through numerous hazardous waste incinerator trial burn-type investigations performed for EPA by the contractor (MRI). Included are normal preparations for sampling points, waste inventory arrangements for performing the tests, and practical considerations for using standard EPA stack sampling techniques, etc. which may otherwise be overlooked by new or unfamiliar contractors conducting future incinerator trial burn sampling.

48463 **(PB—84-201631) Prototype concentration monitor for estimating acidic dry deposition. Interim report April 1983-April 1984.** Durham, J.L.; Ellestad, T.G. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab.). Jun 1984. 15p. (EPA/600—D-84-147). NTIS, PC A02/MF A01.

Dry deposition contributes significantly to the acidification of the ecosystem. However, difficulties in measuring dry deposition of reactive gases and fine particles make routine direct monitoring impractical. An alternate approach is to use the 'concentration monitoring' method in which dry deposition is estimated from the product of measured concentration and estimated deposition velocity. To investigate sampling protocols for estimating the weekly averages of pollutant dry deposition, a sampler that performs over the period of about 0.25 to 7 days, depending on atmospheric concentrations has been developed. It consists of a Teflon cyclone to exclude particles larger than about 2 micrometers, selective solid adsorption media for reactive gases - some of which are sampled from an unstable transition flow to avoid bias from particle evaporation, and a particle filter. The sampler is the first reported application of unstable transition-flow mass transfer for the collection of trace atmospheric gases. Laboratory and limited field tests have shown that the sampler performs satisfactorily for $HNO_3(g)$ and SO_2.

48464 **(PB—84-201680) U.S. EPA (Environmental Protection Agency) regional oxidant model - background and overview.** Schere, K.L.; Possiel, N.C. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab.). Jun 1984. 19p. (EPA—600/D-84-155). NTIS, PC A02/MF A01.

Prepared in cooperation with National Oceanic and Atmospheric Administration, Rockville, MD.

The development of a photochemical model capable of simulating regional transport of ozone and its precursors is the focus of an extensive program now in progress at the U.S. Environmental Protection Agency (EPA). This model, the Regional Oxidant

Model (ROM) is designed for use in evaluating the effectiveness of various control strategies needed to provide for attainment of the ozone NAAQS. The model will be evaluated for the Northeast U.S. where various studies have demonstrated the occurrence of widespread episodes of high ozone concentrations. The purposes of this paper are to highlight the types of issues that could be addressed using the Regional Oxidant Model and to describe the structure of this model.

48465 **(PB—84-204759) Survey of gaseous air pollutants at selected UK sites: XII. Data digest for Hope Street, Glasgow, 1981-1982.** Rogers, F.S.M.; Broughton, G.F.J.; Lilley, K.; Stevenson, K.J. (Warren Spring Lab., Stevenage (UK)). 1983. 79p. NTIS, PC E06/MF E06.

Ambient air quality measurements of carbon monoxide, oxides of nitrogen, sulphur dioxide, particulate lead and black smoke finished at the Hope Street, Glasgow kerbside site in October 1982. The monitoring program is sponsored by the Department of the Environment. The data collected in 1981 and 1982 are presented in the form of frequency distributions, averages and other parameters for the summer of 1981, the whole period of 1981 to 1982, the winter of 1981 to 1982 and the summer of 1982 and also on a month by month basis. For NO and NO2 winter/summer percentile ratios are reported and the NO2 measurements compared with guideline concentrations.

48466 **(PB—84-204767) Survey of gaseous air pollutants at selected UK sites: XIII. Data digest for Cromwell Road, London, 1980-1982.** Rogers, F.S.M.; Broughton, G.F.J.; Lilley, K.; Stevenson, K.J. (Warren Spring Lab., Stevenage (UK)). 1983. 82p. (LR—478(AP)-M). NTIS, PC E06/MF E06.

Ambient air quality measurements of carbon monoxide, oxides of nitrogen, sulphur dioxide, particulate lead and black smoke continued at the Cromwell Road kerbside site during 1982. The monitoring program is sponsored by the Department of the Environment. One direction of traffic flow was also logged. The data collected are presented in the form of frequency distributions, averages and other parameters by season and by month. Concentration-time series plots are included which show all data during the reporting period and monthly parameters between March 1973 and December 1982.

48467 **(PB—84-204825) Survey of gaseous pollutant emissions from tuned in-service gasoline engined cars over a range of road operating conditions: executive summary.** Potter, C.J.; Savage, C.A. (Warren Spring Lab., Stevenage (UK)). 1983. 19p. (LR—470(AP)-M). NTIS, PC E03/MF E03.

The estimation of the contribution made by motor vehicles to the atmospheric burden of pollutants depends critically upon the accuracy with which the emissions of a representative sample of vehicles operating over a wide range of real road conditions are known. In order to obtain such data, a comprehensive program was devised which included tests based on the Economic Commission for Europe Regulation 15. This project formed part of an overall program commissioned by the Department of Transport (DT(p)) in which the Motor Industry Research Association (MIRA) also participated. MIRA procured 204 gasoline engined cars from various sources such as garages, hire companies and privately owned vehicles. The 204 cars were tested by MIRA in the as-received condition in accord with the ECE R15-03 schedule; sixty-four of these cars were then tuned and re-tested. The Mini-CVS proportional sampler system has been thoroughly tested and validated against the normal full-size CVS as used in both the US (Environmental Protection Agency) and the recent '04' series of amendments to the ECE R15 test procedures.

48468 **(PB—84-204833) Survey of gaseous air pollutants at selected UK sites. VIII. Summaries and intersite comparisons, 1978-1980.** Apling, A.J.; Dorling, T.A.; Lilley, K.B.; Rogers, F.S.M.; Stevenson, K.J. (Warren Spring Lab., Stevenage (UK)). 1983. 160p. (LR—404(AP)-M). NTIS, PC E09/MF E09.

This report summarizes, analyses and discusses the air quality data reported previously in the Survey of Gaseous Air Pollutants Data Digest series of reports for the period April 1978-September 1980. The data are analysed in terms of means, peak values and diurnal pattern, and comparisons are made between sites and between pollutants. Extensive summary tables of monthly and seasonal averages are presented.

48469 **(PB—84-204841) Survey of gaseous air pollutants at selected UK sites: IX. Data digest for Sibton, Suffolk, 1980-1982.** Rogers, F.S.M.; Broughton, G.F.J.; Lilley, K.; Stevenson, K.J. (Warren Spring Lab., Stevenage (UK)). 1983. 31p. (LR—474(AP)-M). NTIS, PC E04/MF E04.

Ambient air quality measurement of ozone continued at Sibton, Suffolk between October 1980 and December 1982. The monitoring program is sponsored by the Department of the Environment. The data collected are presented in the form of frequency distributions, averages and other parameters for two winters (October to March), two annual periods (April to March), two summers (April to September) and individual months. Concentration-time series plots for all hourly values between October 1980 and December 1982 and for monthly parameters between July 1973 and December 1982 are included.

48470 **(PB—84-204858) Survey of gaseous air pollutants at selected UK sites: X. Data digest for Stevenage, Hertfordshire, 1980-1982.** Rogers, F.S.M.; Broughton, G.F.J.; Lilley, K.; Stevenson, K.J. (Warren Spring Lab., Stevenage (UK)). 1983. 106p. (LR—475(AP)-M). NTIS, PC E07/MF E07.

Ambient air quality measurements of six gaseous pollutants, continued at Stevenage, Hertfordshire between October 1980 and December 1982. The monitoring program is sponsored by the Department of the Environment. The data collected are presented in the form of frequency distributions, averages and other parameters for two winters (October to March), two annual periods (April to March), two summers (April to September) and individual months. Concentration-time series plots for all hourly values between October 1980 and December 1982 and for two monthly parameters between April 1977 and December 1982 are included.

48471 **(PB—84-204866) Survey of gaseous air pollutants at selected UK sites: XI. Data digest for Central London Laboratory, 1980-1982.** Rogers, F.S.M.; Broughton, G.F.J.; Lilley, K.; Stevenson, K.J. (Warren Spring Lab., Stevenage (UK)). 1983. 129p. (LR—476(AP)-M). NTIS, PC E08/MF E08.

Ambient air quality measurements of six gaseous pollutants plus black smoke and particulate lead continued at the Central London Laboratory between October 1980 and December 1982. The measurements are made as part of two monitoring programs sponsored by the Department of the Environment. The data collected are presented in the form of frequency distrubitions averages and other parameters for two winters (October to March), two annual periods (April to March), two summers (April to September) and individual months. Concentration-time series for the basic data between October 1980 and December 1982 and (for gaseous pollutant) for two monthly parameters between July 1972 and December 1982 are included.

48472 **(PB—84-209386) Health hazard evaluation report No. HETA 82-137-1264, regional transportation district, Denver, Colorado.** Apol, A. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Feb 1983. 27p. NTIS, PC A03/MF A01.

To evaluate possible health hazards associated with exposure to diesel engine exhaust emissions, on March 22-25, 1982, NIOSH collected air samples at the three facilities. Aldehyde concentrations (acetaldehyde, butyraldehyde, formaldehyde, and propionaldehyde) were all less than 0.03 ppm, and sulfur dioxide less than 0.05 ppm. Six of the 15 3-hour samples (range 1.01 to 1.81 ppm) collected in the three facilities during the morning dispatch period exceeded the NIOSH-recommended criterion of 1 ppm for any 15-minute period. Drivers and other workers may spend 15 minutes or more in these areas. The bus drivers in the East Metro and Platte facilities and diesel repair mechanics at the Alameda facility are exposed to nitrogen dioxide in excess of NIOSH-recommended criterion.

48473 **(PB—84-209550) Health hazard evaluation report No. HETA 81-163-1190, GTE Sylvania, Winchester, Kentucky.** Frederick, L.; Zey, J.; Rinsky, R. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Sep 1982. 20p. NTIS, PC A02/MF A01.

On January 14, 1981, NIOSH received a request to investigate five cases of sarcoidosis which occurred over a 5-year period among 750 employees who manufacture specialty light bulbs. The medical/epidemiological evaluation consisted of interviews with the five patients, a review of their medical and personnel records, a search for commonalities among the cases, and an attempt to determine usual incidence rates for sarcoidosis in the general population. NIOSH found that only four of the five identified cases had sarcoidosis as a final diagnosis, three of which were biopsy-confirmed. The fourth had no biopsy, but the other medical findings were characteristics of sarcoidosis. Environmental sampling was conducted for halogenated gases (hydrogen bromide, methyl iodide, and dibromomethane), isopropyl alcohol, ethyl alcohol, methyl alcohol, n-amyl acetate, and inorganic metals including lead, aluminum, silver, iron, zinc, magnesium, phosphorus, and beryllium. Airborne concentrations for all personal exposures were well below currently acceptable limits. NIOSH found no commonalities among the group other than working at the same plant. There were no biologically significant occupational exposures, and specifically, no exposure to beryllium. We were unable to establish a casual relationship between the cases and the work environment.

48474 **(PB—84-210848) Development of the Volatile Organic Sampling Train (VOST) for use in determining incinerator efficiency.** Johnson, L.D. Jun 1984. 18p. (EPA/600—D-84-168). NTIS, PC A02/MF A01.

The paper discusses the development, initial evaluation, and field application to incinerators of a new sampling train for volatile organic species. The Volatile Organic Sampling Train (VOST) is a simple portable device, combining Tenax and Tenax/charcoal cartridges as collection agents. Analysis of the sorption cartridges includes a further concentration step that permits the measurement of stack concentrations as low as 0.1 ng/L. The Resource Conservation and Recovery Act requires owners or operators of hazardous waste incinerators to demonstrate that the incinerator can achieve adequate destruction efficiency of certain compounds before a permit is issued. Many of the compounds that are commonly of interest are of low molecular weight and volatile.

48475 **(PNL—5242) Mesoscale storm and dry period parameters from hourly precipitation data: program documentation.** Thorp, J.M. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1984. Contract AC06-76RL01830. 98p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85001366.

Wet deposition of airborne chemical pollutants occurs primarily from precipitation. Precipitation rate, amount, duration, and location are important meteorological factors to be considered when attempting to understand the relationship of precipitation to pollutant deposition. The Pacific Northwest Laboratory (PNL) has conducted studies and experiments in numerous locations to collect data that can be incorporated into theories and models that attempt to describe the complex relationship between precipitation occurrence and chemical wet desposition. Model development often requires the use of average rather than random condition as input. To provide mean values of storm parameters, the task, Climatological Analysis of Mesoscale Storms, was created as a facet of the Environmental Protection Agency's related-service project, Precipitation Scavenging Module Development. Within this task computer programs have been developed at PNL which incorporate hourly precipitation data from National Weather Service stations to calculate mean values and frequency distributions of precipitation periods and of the interspersed dry periods. These programs have been written with a degree of flexibiity that will allow user modification for applications to different, but similar, analyses. This report describes in detail the rationale and operation of the two computer programs which produce the tables of average and frequency distributions of storm and dry period parameters from the precipitation data. A listing of the programs and examples of the generated output are included in the appendices. 3 references, 3 figures, 6 tables.

48476 **Interaction between air pollution dispersion and residential heating demands.** Lipfert, F.W.; Moskowitz, P.D.; Dungan, J.; Tichler, J.; Carney, T. (Brookhaven National Lab., Upton, NY). *Journal of the Air Pollution Control Association;* **33**: 208-211(Mar 1983). Contract AC02-76CH00016.

The effect of the short-term correlation of a specific emission (sulfur dioxide) from residential space heating, with air pollution dispersion rates on the accuracy of model estimates of urban air pollution on a seasonal or annual basis is analyzed. Hourly climatological and residential emission estimates for six U.S. cities and a simplified area source-dispersion model based on a circular receptor grid are used. The effect on annual average concentration estimations is found to be slight (approximately + or - 12 percent), while the maximum hourly concentrations are shown to vary considerably more, since maximum heat demand and worst-case dispersion are not coincident. Accounting for the correlations between heating demand and dispersion makes possible a differentiation in air pollution potential between coastal and interior cities.

48477 **Case studies of aerosol size distribution and chemistry during passages of a cold and a warm front.** Sheih, C.M.; Johnson, S.A.; Depaul, F.T. (Argonne National Lab., IL). *Atmospheric Environment;* **17**: 1299-1306(1983).

Surface-based measurements of particle size distributions, mass, water content, and the ammonium, sulfate, and nitrate ion concentrations of atmospheric aerosols in and around precipitation events associated with warm and cold frontal passages in a rural area near Fort Wayne, Indiana during April 1981 are reported. The prerain volume concentration of aerosol size distribution was generally bimodally peaking, at about 0.7 micron for the fine mode and 7-10 microns for the coarse mode. Precipitation scavenging appeared to remove effectively coarse aerosols, but had a smaller effect on fine ones. The coarse concentration recovered to 50 percent of its prerain value 3-4 hr after the rain. Aerosol water content for all cases was found to range from about 20 to 95 percent of the total aerosol weight. Sulfate and ammonium ion occurred generally in the fine size range, while no aerosol size preference appeared for nitrate.

48478 **Determination of chrysotile asbestos in building materials by x-ray diffractometry.** Dunn, H.W.; Stewart, J.H. Jr. (Oak Ridge National Lab., TN). *Analytical Chemistry;* **54**: No. 7, 1122-1125(Jun 1982). Contract W-7405-ENG-26.

An X-ray diffractometry technique using an internal standard has been developed for the quantitative measurement of the chrysotile asbestos content of a wide variety of construction materials. This technique is simple and cost effective compared with the usual need for combined X-ray powder diffraction patterns and optical or transmission electron microscopy to determine the asbestos content of materials. The diffractometry method is designed to differentiate between construction materials which are not asbestos contaminated and those which require costly special handling to ensure employee safety. The asbestos concentration range between 0.5 and 5.0% was initially investigated to meet the 1.0% asbestos Environmental Protection Agency National Emission Standards regulation and has now been extended to determine as much as 50% chrysotile.

48479 **Pollutants from the sky.** Parker, J.I. Argonne, IL, USA; Argonne National Laboratory ([1984]). 3p.

This is a general article concerning the effect of air pollution on the Great Lakes. Sources of various pollutants, (mostly trace metals) are discussed, as well as some aspects of the atmospheric chemistry of the pollutants. Basic mechanisms whereby the lakes receive contaminants are also discussed, along with some of the biological effects of some pollutants.

5003 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 50030047507, 47510, 47545, 47554, 47825, 48441, 48495, 48496

48480 (AD-A—140111/6) Fallout: its characteristics and management. Technical report. Ferlic, K.P. (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). Dec 1983. 103p. NTIS, PC A06/MF A01.

This report is a comprehensive single-source summary of the salient features of fallout. It supplements the fallout lectures of the Medical Effects of Nuclear Weapons course given by AFRRI. The following topics are included: Basic physical processes that give rise to formation of fallout; identification of primary factors governing magnitude of the fallout problem; design and deployment of weapons and their effect on fallout formation; sources of fallout; weapon yield and atmospheric structure in region of detonation, including effects of local meteorological conditions on early fallout; theoretical and actual fallout patterns, with emphasis on the latter and on experience gained from atmospheric testing; expected type of fallout deposition; identification of types of radiation associated with fallout, and discussion of their radiological properties; protection against each type of radiation; external hazards of fallout; major concerns of ingesting fallout; discussion of each major isotope of concern with particular attention to current ICRP (International Commission on Radiation Protection) dose estimates for ingestion; brief description of management of fallout, including (a) detection of fallout and evaluation of hazards based or radiological dose considerations, fallout shelters, personnel decontamination, and food sources, and (b) postattack recovery.

48481 (N—84-24022) Measurements concerning increase of atmospheric radiokrypton content. Csongor, E. (Joint Publications Research Service, Arlington, VA (USA)). Mar 1984. 10p. NTIS, PC A03/MF A01.

Measurements to detect increase in radiokrypton content in the atmosphere were taken. Methods of measurement and problems encountered are outlined in this report.

48482 (N—84-24023) Measurements of atmospheric Kr-85 concentration at ATOMKI from 1966 to 1977. Csongor, E. (Joint Publications Research Service, Arlington, VA (USA)). Mar 1984. 13p. NTIS, PC A03/MF A01.

The author first provides a review of the various methods used thus far to measure the Kr-86 concentration and of enrichment and measurement procedures. Measurements done regularly at ATOMKI since 1966 are described.

48483 (N—8424021) Article examines presence of Kr-85 in atmosphere. Csongor, E. (Joint Publications Research Service, Arlington, VA (USA)). Mar 1984. 6p. NTIS, PC A03/MF A01.

The radioactivity of the atmosphere has increased gradually in the past 15 years as a result of human activity as artificial radioactive materials get into the atmosphere as a result of fission and fusion processes. The noble gases arising during fission represent an exception; they do not form compounds in the atmosphere and do not adhere to dust particles. The noble gas isotopes are given with half lives longer than one hour arising in the fission of various heavy nuclei and their fission yields in percent. During fission there arise 16 isotopes of Kr and 20 isotopes of Xe of these 10 are stable, the rest decay with short or very short half lives. The only exception is Kr-85, the half life of which is 10.76 years. The Kr-85 arising during nuclear weapon experiments gets into the atmosphere. The purpose of this study was to measure the Kr-85 content in the atmosphere.

48484 (PB—84-207554) EPA (Environmental Protection Agency) Environmental Modeling Catalogue: abstracts of environmental models. (Systems Architects, Inc., Randolph, MA (USA)). Aug 1982. 421p. NTIS, PC A18/MF A01.

The Environmental Modeling Catalogue represents a part of EPA's efforts to establish communication and share information among researchers interested in modeling applications and techniques.

5005 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 50050047669

5006 Regulations

REFER ALSO TO CITATION(S) 50060047930, 47931, 47932, 47933, 47934, 47935, 47936, 47937, 47938, 48478

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

5101 Basic Studies

48485 (INIS-mf—8864) Proposal to assess the settlement and subsidence behaviour of noncohesive soils after wetting. Hellweg, V. (Hannover Univ. (Germany, F.R.). Fakultaet fuer Bauwesen). 1981. 136p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE84780572.

On the basis of the causes established for the Elbe-Seitenkanal dyke breach in 1976 - which was due a.o. to the settlement of the uniform fine sand placed-serial ground subsidence investigations according to a test method developed by the author were carried through in high-grade steel cylinders of 35 cm diameter and 70 cm height with three very different noncohesive soils to assess the subsidence behaviour after wetting. Besides a critical evaluation of the so far known methods for assessing ground subsidence and direct comparisons with other authors' results and usual laboratory test results, the processes inside the soil samples placed were carefully observed and analysed with the aid of the large experimental devices used. (orig./MSK).

48486 (LA—9236-NERP) La Mesa Fire Symposium. Foxx, T.S. (comp.). (Los Alamos National Lab., NM (USA)). Feb 1984. Contract W-7405-ENG-36. 172p. (CONF-8110316—). NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE84010095.

From La Mesa fire symposium; Los Alamos, NM, USA (6 Oct 1981).

Edited versions of papers given to the La Mesa Fire Symposium are presented. The papers contain results of numerous studies made after the fire and results of some studies that were in progress when the fire began. Preceding the papers is a brief introduction describing the physiography and climatology of the fire; the fire's growth and containment; and the importance of fire in ponderosa pine.

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 51020047347, 47348, 48450, 48484, 48576, 48578, 48594, 48596

48487 (DOE/ER/60179—1) Chemical processes in forest soils. Progress report, August 1, 1983-July 1, 1984. Zelazny, L.W.; James, B.R.; Bartlett, R.J. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). Jul 1984. Contract AS05-83ER60179. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85001620.

This progress report is presented in 3 parts which describe a series of experiments conducted to determine the influence of various components of acid precipitation on nutrient leaching and aluminium availability in soils. Soil samples were collected in Virginia, New York, and Vermont. Results suggest that pH, SO_4, dissolved organic carbon and NO_3 levels all influence aluminium solubility. 15 references, 7 figures, 1 table. (MF)

48488 (DOE/EV/01199—64, pp 251-276) Feasibility study to assess the impact of precipitation quality on soil water quality. Bowersox, V.C. Sep 1984. NTIS, PC A16/MF A01. File Number TI84017449.

In Study of atmospheric pollution scavenging. Twentieth progress report.

This study was initiated to establish protocol for investigating the impacts of precipitation quality on soils and soil water quality. The emphasis of the research is on soil water extracted from the unsaturated zone (above the water table) and on tracing the contribution of the major inorganic ions in precipitation to the chemistry of the soil water. 15 references, 7 figures, 4 tables.

48489 (FWS/OBS—80/40.6) Air Pollution and Acid Rain, Report 6. The effects of air pollution and acid rain on fish, wildlife, and their habitats: forests. Borghi, L.; Adler, D. Jun 1982. 93p. NTIS, PC A05/MF A01 - GPO*. File Number TI84901661.

Air pollution and acid rain impacts on living resources are a major source of concern to the US Fish and Wildlife Service and other government agencies charged with the protection of natural resources and the environment. This volume on forest ecosystems is part of a series synthesizing the results of scientific research related to the effects of air pollution and acid deposition on fish and wildlife resources. The first chapter presents an overview of forest ecosystems in the United States and summaries of the effects of air pollutants on forests, the factors that determine the type and degree of effects to be expected, and the primary research needs. The bulk of the report summarizes the current state-of-knowledge in this problem area. Effects are discussed within the following pollutant categories: photochemical oxidants, particulates, fluorides, and acidifying air pollutants. 179 references, 4 figures, 10 tables.

48490 (PB—84-211317) Single laboratory evaluation of the hydrogen oxidation soil bioassay. Rogers, R.D. (EG and G Idaho, Inc., Idaho Falis (USA)). Jun 1984. 54p. NTIS, PC A04/MF A01.

The Hydrogen Oxidation Soil Bioassay was single laboratory tested as a potential method for monitoring hazardous wastes and hazardous waste sites. The bioassay is based on the rate of hydrogen consumption by soil microorganisms. Oxidation of hydrogen to water is inhibited when various pollutants are present in the soil and the rate of this reaction can be used as an indication of potential hazard to the soil ecosystem. The single laboratory evaluation included ruggedness testing, a determination of method sensitivity and precision, and tests to determine the limits of reliable measurement. Aqueous solutions of mercuric chloride were used as sample material during the evaluation. Some preliminary tests were also conducted using both organic compounds and actual hazardous waste samples. The bioassay was found to be 'rugged' in the sense that modest procedural variations did not produce an altered test result. The complete Hydrogen Oxidation Soil Bioassay protocol, the results of chemical analyses conducted on actual samples that were used during the single laboratory test, and the preliminary bioassay responses to different types of sample material are included in the project report.

48491 Extent and impact of mercury releases and other pollutants at the Department of Energy's Oak Ridge complex at Oak Ridge, Tennessee. Report by the Committee on Science and Technology submitted to the Ninety-Eighth Congress, First Session. Washington, DC, USA; Government Printing Office (1983). 44p.

This report discusses the loss to the environment of 2.4 million pounds of mercury at the Department of Energy's Y-12 Plant in Oak Ridge and examines the state of the environment at DOE's Oak Ridge Complex. Four broad issues formed the basis for the investigation: (1) hazards posed by the pollution, (2) DOE and Union Carbide Corp. Nuclear Division conduct, (3) data collection and remedial actions, and (4) obstacles to pollution control. Three recommendations were made by the Subcommittee: (1) an independent scientific review group will assess and monitor the mercury pollution problems and the potential impact of other pollutants, (2) DOE/ORO must submit a comprehensive program management plan to deal with the problem, and (3) DOE and EPA must continue their discussions to resolve outstanding disputes regarding federal environmental laws and a report must be submitted on progress made.

48492 Flow of microbially fixed nitrogen in a model ecosystem. Visser, S.A.; Witkamp, M.; Dahlman, R.C. (Oak Ridge National Lab., TN). *Plant and Soil;* **38:** No. 1, 1-8(Feb 1973).

Preceding oberservations showed that both Azotobacter and a mixed flora with Azotobacter are about equally capable for fixing atmospheric nitrogen. During subsequent transfer of the nitrogen there was a distinct differentiation between movement of the newly fixed nitrogen and the nitrogen that was already present in tissues introduced in the beginning of the experiment. Pathways and transfer coefficients of both N^{14} and N^{15} were different in the presence of the different microbial populations. Turnover was more complex and in general slower in the presence of a mixed population than with pure Azotobacter. The lower transfer coefficients in the mixed populations may reflect more recycling within these populations than in pure cultures of Azotobacter. Denitrification losses upon acidification were negligible for N^{14}. The effect of acidification tended to be greater in systems with pure cultures of Azotobacter than in systems with a mixed culture.

5103 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 51030047503, 47504, 47505, 47506, 47545, 47554, 47572, 47861, 48480, 48484

48493 (INIS-mf—9040, pp 78-80) **Use of uranium-series disequilibrium to determine radionuclide migration on geologic time scales.** Gascoyne, M. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

48494 (INIS-mf—9040, pp 148-150) **Approximate analytical procedure for solving a radionuclide transport equation.** Moltyaner, G.L. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

48495 (SCPRI-RM—10-1983) Monthly results of measurement. October 1983. (Service Central de Protection contre les Rayonnements Ionisants, 78 - Le Vesinet (France)). Oct 1983. 35p. (In French). NTIS (US Sales Only), PC A03/MF A01. File Number DE84751755.

Measurement tables concerning the surveillance of the environment in France (see also the SCPRI-RT–3-1983).

48496 (SCPRI-RT—3-1983) 3. Quarterly progress report, 1983. (Service Central de Protection contre les Rayonnements Ionisants, 78 - Le Vesinet (France)). Jul 1983. 39p. (In French). NTIS (US Sales Only), PC A03/MF A01. File Number DE84751754.

This report of the SCPRI exposes an interpretation of the principal results concerning the surveillance of radioactivity in the environment: atmospheric dusts, rainwater, surface water, underground water, irrigation water, drinking water, food chain, sea water around nuclear plant sites and other sites. The activities of various radioisotopes are presented in tables (^{7}Be, ^{95}Zr and ^{95}Nb, ^{103}Ru, ^{131}I, ^{137}Cs, ^{140}Ba and ^{140}La, ^{90}Sr, ^{106}Ru and ^{106}Rh, ^{226}Ra, ^{54}Mn, U and T. A bibliographic selection si also presented.

5105 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 51050047350, 47353, 47354, 47355, 47357, 47359, 47360, 47529, 47560

48497 (EPRI-EA—3681) Environmental settings and solid-residues disposal in the electric utility industry. Final report. Purkiss, F.C. Aug 1984. 106p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920002.

This report summarizes the Environmental Settings and Solid Residues Disposal Database. It includes the development of the database, sources accessed, software used for the database and a summary of data obtained. The objective of the study was the development of a database that would contain information on the environmental setting of every oil and coal-fired generating station with units over 100MW in the United States. This data was to be used to focus and direct studies being sponsored by the EPRI Solid Waste Environmental Studies (SWES) Program. The environmental setting consists of data on the plant characteristics, meteorology, soils, geology and hydrology. The sources of data are readily available public documents and reports that would have data available at a detail of county level or better. The report contains data on a total of 451 power plants. Data availability ranges from very complete for plant characteristics and meteorological data to very little data for geology and hydrology. Soils data was available for a little less than half of the plants. The data is retrievable and can be analyzed by use of the Digital Equipment Corporation Datatrieve Software System. 6 figures, 42 tables.

48498 **(PB—84-203496) Material durability in aggressive ground.** Barry, D.L. 1983. 67p. NTIS, PC $30.00/MF $30.00.

The report alerts those concerned with redevelopment to the susceptibility of buried construction materials to attack by, and degradation from, aggressive conditions, particularly those resulting from former industrial site use. Principal aggressive chemical compounds are listed and related to conventional construction materials used underground. Some industrial sources of these chemical compounds are given, and potential construction and durability problems are identified. Design procedures which can be adopted are also outlined.

52 ENVIRONMENTAL SCIENCES, AQUATIC

5201 Basic Studies

48499 **(AD-A—141895/3) Stable carbon isotopes in seawater.** Deuser, W.G.; Hunt, J.M. (Woods Hole Oceanographic Institution, MA (USA)). 1974. 10p. NTIS, PC A02/MF A01.

The program aims at an understanding of the relationships that exist between the many varied phases of carbon in the ocean, their relation to other phases in the oceanic environment, and the source, fate and regeneration of carbon phases. Stable isotopes provide an excellent means for detecting many of these relationships because they represent characteristic natural labels which allow us to trace the path of carbon in its natural cycle from one phase to another. Our results have a direct bearing on the identification of water masses and the extent and rate of vertical and horizontal mixing in the ocean. Our data from the Atlantic showed an excess of biogenic carbon at the depth of the oxygen minimum. This suggests horizontal advection of waters low in oxygen and high in biogenic carbon and supports the theory that the oxygen minimum layer is not merely a locally originating phenomenon but rather forms in the eastern tropical regions of high productivity and spreads horizontally from there. Much of our effort during the past year was centered on a thorough investigation of the carbon cycle in the Black Sea. The Black Sea has two features which make it particularly interesting: (a) it is a basin which is nearly isolated from the Mediterranean and thereby the world's oceans, (b) below an aerated top layer of 125 to 250 m thickness the water is anoxic, i.e. it contains no dissolved oxygen but rather hydrogen sulfide whose amounts increase with depth.

48500 **(GSF-R—328) GSF Institut fuer Radiohydrometrie: Annual report 1982.** (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.)). Jun 1983. 212p. (In German). Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.).

The report discusses new developments in measuring instruments and techniques for D, T, C-13, 14, O-18, and Kr-85 measurement and gas analysis. Isotope-hydrological and geohydrological studies especially on precipitations, ground water, seepage water, trees and wood using the tracer and single-well-pulse techniques. Applications of the single-well technique, fluorescent labels, the storage of radioactive waste, and problems of glacial hydrology were investigated.

48501 **(NP—4901954) Efficacy of Sameodes albiguttalis as a biocontrol of waterhyacinth. Final report.** Center, T.D.; Durden, W.C.; Corman, D.A. Jan 1984. 252p. NTIS, PC A12/MF A01. File Number TI84901954.

Technical report A-84-2.

Sameodes albiguttalis (Warren) is a South American pyralid moth species which was released in Florida in 1977 for the biological control of waterhyacinth. After it was determined that populations of this insect had become established in the field, various efficacy studies were begun. The first of these began in September 1978 and, ultimately, data were collected at 15 sites from throughout Florida. The objectives of these studies were to determine (a) if S. albiguttalis would be persistent, (b) if it could be augmented if it were not persistent, and (c) if it had a significant impact upon waterhyacinth populations within the context of comparisons among other control agents and the plant's ability to recover from serious injury. Data indicate that S. albiguttalis will, under certain conditions, be an effective biological control of waterhyacinth. This will generally be only where the waterhyacinth population is in a predominantly colonizing mode. Sameodes albiguttalis, more than either of the other two waterhyacinth insects (Neochetina eichhorneae and N. bruchi), should fit comfortably into a management scheme. Its effectiveness may be maximized in a maintenance program where the waterhyacinth population is constantly perturbed and is always in a colonizing mode. Many possible management strategies exist in which this insect and herbicidal or mechanical control could be integrated and experimentation along these lines should be given a high future priority. 61 references, 109 figures, 4 tables.

48502 **(PB—84-190131) Effects of urbanization on physical habitat for trout in streams.** White, R.J.; Wells, J.D.; Peterson, M.E. Oct 1983. 50p. NTIS, PC A03/MF A01.

Prepared in cooperation with Montana State Univ., Bozeman and Montana Dept. of Fish, Wildlife and Parks, Bozeman.

Non-urban were more favorable than urban stream sections as habitat for trout and held more trout. The major habitat difference was amount of instream solid overhead hiding cover. Urban land modifications had created unnaturally straight, narrow channels with high, unstable banks with little of the undercuts and woody debris that provide shelter for fish. Urban and non-urban sections did not differ significantly with respect to water velocity, dissolved nitrate, or amount of pools or water turbulence. Per unit stream length, non-urban sections averaged 54% more trout larger than 20 (8 inches) and 74% greater total trout biomass than urban sections. In both urban and non-urban areas, trout abundance as kg/ha was generally below the level predicted by the Wyoming Habitat Quality Index (HQI). This could have been due to effects of angling or other unmeasured factors, to measurement errors or to inapplicability of the HQI method to the areas studied. There is evidence that altering the HQI method to consider solid overhead hiding cover and pool-turbulence hiding cover as separate variables rather than as a total cover index will enhance predictiveness.

48503 **(PB—84-202498) Analysis of pollutant enhanced bacterial-blue-green algal interrelationships potentiating surface water contamination by noxious blue-green algal blooms. Completion report.** Bedell, G.W. Feb 1984. 15p. NTIS, PC A02/MF A01.

Sulfate-reducing bacteria from the genus Desulfovibro can stimulate the blue-green alga (Cyanobacterium) Anabaena variabilis (Strain 6411) into increasing its dry weight biomass production by more than 200 percent over that of the control as the total phosphate in the medium approaches zero. Results suggest that methods which utilize total nitrogen to phosphorus ratios in waters as predictors of blue-green algal 'blooms' may be unreliable when the waters are very low in phosphorus yet remain high in sulfate with conditions favorable for sulfate-reducing bacterial growth in benthic sediments. Otherwise, if the phosphate levels alone in the aqueous systems are reduced below threshold levels under these conditions, the magnitude of the blue-green algal blooms may be increased substantially.

5202 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 52020047314, 47362, 47365, 47439, 47441, 47466, 47467, 48440, 48452, 48453, 48454, 48455, 48456, 48457, 48458, 48459, 48460, 48491, 48521

48504 **(CONF-8404156—2) Protecting aquatic resources: an ecologist's perspective.** Giddings, J.M. (Oak Ridge National Lab., TN (USA)). 17 Apr 1984. Contract AC05-84OR21400. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85000901.

From 8. symposium on aquatic toxicology; Ft. Mitchell, KY, USA (15 Apr 1984).

Because natural populations are linked by a variety of ecological interactions (e.g., predation and competition), the response of any particular population to chemical exposure depends on how the rest of the ecosystem is affected. Mathematical models and field experiments demonstrate that such interactions can amplify or diminish the impacts of contaminants on populations. When direct toxic effects result in persistent, significant changes in some parts of an ecosystem, other populations in the ecosystem become vulnerable to indirect effects. Protection of aquatic populations, then, requires protection of aquatic ecosystems. The threshold of persistent, significant damage to an ecosystem is a distinct discontinuity in the gradient of ecosystem response to increasing chemical exposure. The safe level of exposure for an aquatic ecosystem can be determined experimentally using microcosms or field enclosures. It is hypothesized that safe exposure levels for ecosystems are usually near the lower end of the chronic toxicity range for single species. Data on chemical effects in ecosystem are needed in order to calibrate standard bioassays and to verify the accuracy of methods for extrapolating from bioassay results to nature. 16 references, 1 figure.

48505 **(FWS/OBS—80/40.5) Air Pollution and Acid Rain, Report 5. The effects of air pollution and acid rain on fish, wildlife, and their habitats: rivers and streams.** Potter, W.; Chang, B.K.Y. Jun 1982. 58p. NTIS, PC A04/MF A01 - GPO*. File Number TI84901664.

This report on rivers and streams is part of a series synthesizing the results of scientific research related to the effects of air pollution and acid deposition on fish and wildlife resources. The effects of photochemical oxidants, particulates, and acidifying air pollutants on water quality and river and stream biota are summarized. The characteristics that reflect river and stream sensitivity to air pollutants, in particular acidifying pollutants, are presented. Socioeconomic aspects of air pollution impacts on river and stream ecosystems are discussed. 71 references, 2 figures, 5 tables.

48506 **(JEN—212-DQ/I-74) Study of the influence of calcium, magnesium and sodium in a method of spectrographic analysis of natural waters.** Diaz-Guerra, J.P.; Capdevila, C. (Junta de Energia Nuclear, Madrid (Spain)). 1969. 25p. (In Spanish). NTIS (US Sales Only), PC A02/MF A01. File Number DE84901929.

The influences of 1000μg/ml of calcium and sodium and 300 μg/ml of magnesium, on the spectrographic determination of Al, Ba, Cr, Fe, Li, Mn, Ni, Pb, Sr, and Ti, minor constituents in natural waters, have been studied. In order to eliminate them the elements Ga, In, La, Tl and Zn, as well as a mixture containing 30% Tl-70% In, have been tested as spectrochemical buffers. By means of the mentioned mixture and Ga, Tl and Y as internal standards, the accuracy obtained for the quantitative determinations is better than 10%. On the other hand, the semiquantitative determinations are improved through the use of Ga, In, or the Tl-In mixture. A further study has shown that it is possible the determination of some of the elements up to a concentration of 4000 μg/ml of calcium, sodium, or both. The average standard deviation is about +-6%. 7 references, 8 figures, 11 tables.

48507 **(PB—84-194612) Potential for biodegradation of organo-chlorine compounds in groundwater.** Wilson, J.T.; Cosby, R.L.; Smith, G.B. May 1984. 17p. (EPA/600—D-84-138). NTIS, PC A02/MF A01.

Halogenated aliphatic and aromatic hydrocarbons are the most important organic contaminants of shallow water-table aquifers. Such aquifers have recently been shown to harbor an indigenous microflora. Organisms in authentic and uncontaminated samples of unconsolidated subsurface material degraded styrene and toluene. Samples from one site also degraded chlorobenzene. Samples from three sites could not degrade tri- or tetrachloroethylene, 1,1,1- or 1,1,2-trichloroethane, 1,1- or 1,2-dichloroethane or chloroform at rates greater than 2% per week.

48508 **(PB—84-207364) Coagulation and restabilization of particulate, macromolecular and protected organic aquasols by aluminum(III). Project completion report.** Rubin, A.J.; Schroeder, P.R. Mar 1984. 99p. (R—711522). NTIS, PC A05/MF A01.

Prepared in cooperation with Ohio State Univ., Columbus, Dept. of Civil Engineering.

Chemical coagulation processes for the removal of particulate organic soils including suspensions of finely-ground coal, starch and mineral oil emulsions were studied. The specific objectives of the project were to examine the effects of pH, neutral salts and hydrolyzing aluminum salts on the stability of these organic colloids and to determine the mechanisms by which these aggregates operate. Stability limit diagrams were developed for each system. The principal zone of aggregation for those systems using hydrolyzing aluminum salts was the central sweep zone. For both coal and starch, aggreagation in the sweep zone was by enmeshment of the colloid in the floc particles of the aluminum hydroxide precipitate. The aggregation of simple mineral oil emulsions by aluminum sulfate was, for the most part, typical of hydrophobis soils.

48509 **(PB—84-211614) EPA (Environmental Protection Agency) method study 20, method 610--PNA's (polynuclear aromatic hydrocarbons). Final report 20 September 1978-31 October 1984.** Kinzer, G.; Riggin, R.; Bishop, T.; Birts, M.A.; Strup, P. (Battelle Columbus Labs., OH (USA)). Jun 1984. 148p. NTIS, PC A07/MF A01.

Sixteen laboratories participated in an interlaboratory study conducted to provide precision and accuracy statements for the proposed EPA Method 610 for 16 selected polynuclear aromatic hydrocarbons(PNA's) which may be present in municipal and industrial aqueous discharges. Method 610 involves extraction of the pollutants with methylene chloride and subsequent analysis of the subject compounds by high performance liquid chromatography utilizing fluorescence and ultraviolet detection of the PNA's. The study design was based on Youden's plan for collaborative tests of analytical methods. Three Youden pair samples of the test compounds were spiked into six types of test waters and then analyzed. The resulting data were statistically analyzed using the computer program entitled 'Interlaboratory Method Validation Study' (IMVS). Mean recoveries of the PNA's were in the range of 41-100 percent. Overall precision was in the range of 23-91 percent and single-analyst precision was in the range of 11-48 percent. A statistically significant effect due to water type was established for six of the sixteen PNA compounds for which recoveries from distilled water were generally lower than from wastewaters. The effect was judged to be due to the analytical learning process and, therefore, of no practical importance. For the other 10 PNA's, there were no differences of practical significance due to water types among mean recoveries, overall precisions, or single-analyst precisions.

48510 **(PB—84-212448) EPA (Environmental Protection Agency) method study 24, method 601--purgeable halocarbons by the purge trap method. Final report September 1979-December 1982.** Warner, B.J.; Friedman, C.S.; Metcalfe, L.; Morrow, T.J.; Snyder, A.D. Jul 1984. 269p. NTIS, PC A12/MF A01.

The experimental design and results of a validations study for an analytical method to detect 29 halocarbons in water are described herein. In Method 601, the halocarbons are purged by an inert gas which is bubbled through the aqueous sample. The vapors are then trapped in a short column containing a suitable sorbent. The trapped components are then thermally desorbed onto the head of a chromatographic column and measured by means of halide specific detector. In this study, the 29 halocarbon compounds were divided into three separate mixes to minimize interferences from co-eluting peaks. The spiking solutions employed in the study contained the 29 halocarbons at six concentrations. Six water matrices were used in the study: distilled water, drinking water, and a surface water all supplied by the cooperating laboratories; and three industrial wastewaters supplied by the Monsanto Company. Statistical analyses and conclusions in this report are based on analytical data obtained by 20 collaborating laboratories.

48511 (Y/DZ—110) **Mercury removal from water.** Makarewicz, M.A.; Hancher, C.W.; Meredith, P.F. (Oak Ridge Y-12 Plant, TN (USA)). 15 Aug 1984. Contract AC05-84OS21400. 40p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85000383.

Current best available technology and new techniques were investigated to treat mercury-contaminated water to less than 2 μg/L. The most efficient technique found was a ferrous sulfide modified anion exchange resin. The resin was tested in laboratory and pilot-scale tests, and was used on a production basis to treat over 1 x 10^6 gallons of low-level mercury waste water to less than 2 μg/L. 5 references, 19 figures, 8 tables.

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 52030047545, 47554, 47557, 47558, 47559, 48136, 48480, 48495, 48496

48512 (INIS-mf—9040, pp 253-255) **Mobility of Cs-137 in the Ottawa River near the CRNL waste management areas.** Cornett, R.J.; Cooper, E.L.; Lahaie, G. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

48513 (PB—84-190396) **Metal speciation in surface waters of the Great Lakes region. Annual report (final).** Giesy, J.P. (Michigan State Univ., East Lansing (USA). Dept. of Fisheries and Wildlife). 30 Sep 1983. 64p. NTIS, PC A04/MF A01.

Predicting the dynamics of trace metals such as uranium by thermodynamic prediction models is contingent upon accurate stability constants. Conditional stability constants (K') for the binding of uranyl ion UO2(+2) to humic substances were determined by both Scatchard analyses and by fitting the data to a Gaussian model of multiple sites. UO2(+2) was separated from that which was bound to humic material by ion exchange. Uranium concentration was measured by laser fluorometry. There is a broad range of strengths of sites such that K' was dependent on the UO2(+2)/humic ratio. The maximum binding capacity of the humic material was .000483 M/g. The log K' determined for log metal/ligand ratios of -1.5 to -0.5, the ecologically significant range of interest for UO2(+2), which was from 10 - 50 microgram/l at the carbon concentration of 2.36 mg/l used in this study, was determined by Scatchard analysis to be 7.38. The estimate based on a Gaussian distribution was 6.85.

48514 (UILU-WRC—84-187) **Isotopic studies of the natural sources of radium in groundwater in Illinois. Final technical completion report.** Gilkeson, R.H.; Perry, E.C. Jr.; Cowart, J.B.; Holtzman, R.B. (Illinois Univ., Urbana (USA). Water Resources Center). Apr 1984. Contract W-31-109-ENG-38. 54p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85000073.

Stable and radioactive isotopes in groundwater were studied in an investigation of the natural geologic sources of high concentrations of ^{226}Ra and ^{228}Ra in confined aquifers in the Cambrian and Ordovician bedrock of northern Illinois. The covariation of δ^{18}O values (-6.6 to -7.9^0 /$_{00}$) that are similar to contemporary meteoric water. However, a source of recharge related to glaciation is required for groundwater in confined aquifers of the Cambrian and Ordovician that is significantly depleted in ^{18}O (δ^{18}O values range to -12.7^0/$_{00}$ and are less than -9^0/$_{00}$ over large regions). The covariation of δ^{34}S and δ^{18}O in dissolved sulfates determined a mixing line between two sources: oxidation of sulfide minerals and dissolution of marine evaporites. Dissolved sulfates from evaporite sources are present in large concentrations in confined aquifers but are of a different isotopic composition than evaporites of Cambrian or Ordovician age. Glaciation may be important with regard to recharge of the sulfates. The ^{234}U/^{238}U activity ratio in groundwater from the Cambrian and Ordovician are unexpectedly high; values range from 2.1 to 40.7. The lowest ratios occur in primary recharge zones. In confined aquifers values are greater than 20 over large regions. Alpha recoil damage is a mechanism that contributes to the disequilibrium. However, the regional variation in activity ratios and in ^{234}U concentrations supports the concept that glacial recharge has contributed to the high ratios. Radiological and geochemical mechanisms that partition ^{238}U, ^{234}U and ^{230}Th on the sandstone matrix are important to the dissolved ^{226}Ra concentration. 38 references, 11 figures.

5204 Thermal Effluents Monitoring And Transport

48515 (PB—84-180280) **Long-term salinity, temperature and current measurements in upper Chesapeake Bay. Final report.** Hamilton, P.; Boicourt, W.C. (Science Applications, Inc., Raleigh, NC (USA)). Jan 1984. 120p. NTIS, PC A06/MF A01.

Prepared in cooperation with Maryland Univ., Cambridge.

The purpose of this study was to gather data on temperature, salinity and current velocity in the upper Chesapeake Bay for a period of a year. These data represent the longest continuous record of current measurement to date. This study was performed by Science Applications, Inc. The Maryland Power Plant Siting Program provided funds for the project under contract PB81-81-04.

5205 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 52050047350

48516 (DOE/BP—243-Vol.1) **Natural propagation and habitat improvement. Volume I. Oregon. Final and annual reports, 1982/1983.** Apr 1984. 281p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE84013181.

Part of the projects under Bonneville Power Administration's program to protect, mitigate and enhance fish and wildlife affected by the development and operation of hydroelectric facilities on the Columbia River and its tributaries are presented. Projects specifically associated with the Clackamas, Hood, Deschutes, John Day and Grande Ronde Rivers are discussed.

48517 (DOE/BP—244) **Natural propagation and habitat improvement. Volume I. Oregon. Supplement A. Evaluation of fisheries enhancement projects on Fish Creek and Wash Creek. Annual report, 1983.** Everest, F.H.; Sedell, J.R. Apr 1984. 121p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE84017285.

Habitat improvements for anadromous salmonids on Fish Creek in the upper Clackamas Basin were evaluated. The primary objectives of the evaluation effort include: (1) evaluate and quantify the changes in salmonid spawning and rearing habitat resulting from a variety of habitat improvements; (2) evaluate and quantify the changes in fish populations and biomass resulting from habitat improvements; and (3) evaluate the cost-effectiveness of habitat improvements developed with BPA and KV funds on Fish Creek. This report integrates data for the evaluation efforts collected in the Fish Creek Basin in 1982 and 1983. 3 references, 34 figures, 23 tables.

48518 (SREL—16) **Evaluation of the consequences of thermal isolation on biota of upper Steel Creek.** Gladden, J.B. (Savannah River Ecology Lab., Aiken, SC (USA)). Apr 1984. Contract AC09-76SR00819. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85001951.

The objective of this report is to summarize and evaluate existing data concerning the upper reaches of Steel Creek on the Savannah River Plant (SRP) near Aiken, South Carolina. This report addresses the current ecological status of this stream section and the need and/or desirability of maintaining an ambient water temperature zone of passage with lower Steel Creek or the nearby Meyers Branch, an undisturbed watershed that is a major tributary to Steel Creek. The specific case evaluated involves the construction of an 800 to 1000 acre cooling reservoir on Steel Creek upstream of the confluence of Steel Creek and Meyers Branch. Water temperatures exiting this reservoir are assumed to never exceed 90°F. Studies were conducted in connection with the proposed restart of the L-Reactor at SRP. 8 references, 3 figures, 2 tables.

53 ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

5301 Social And Economic Studies

REFER ALSO TO CITATION(S) 53010047524, 47525, 47533, 47548, 47921

5302 Assessment Of Energy Technologies

REFER ALSO TO CITATION(S) 53020047496

5303 Environmental Impact Statements

48519 (DOE/EIS—0095F-Vol.1) **Expanded Residential Weatherization Program. Final environmental impact statement. Volume 1.** Aug 1984. 441p. (DOE/BP—264-Vol.1). NTIS, PC A19/MF A01; GPO Dep. File Number DE84016329.

BPA proposes to expand its present Residential Weatherization Program, which excludes certain types of residences from receiving air-infiltration reducing (tightening) measures. These tightening measures are storm windows and doors, wall insulation, weatherstripping, caulking, and electrical switchplate and outlet gaskets. The major effects examined pertain to air quality (indoor and outdoor), public health, energy, socioeconomic and institutional changes. This Environmental Impact Statement (EIS) evaluates the effects of five alternative actions: (1) No-Action Alternative would not expand BPA's present program; (2) Proposed Action would offer tightening measures to all presently excluded residences; (3) Delayed Action Alternative would postpone an expansion of the present BPA program from 3 to 5 years to allow for further research on indoor air quality and associated health effects; (4) Environmentally Preferred Alternative would offer the same measures as the BPA Preferred Alternative. Mitigation in the form of air-to-air heat exchangers would be provided to return air infiltration rates in residences to their original pre-weatherized amount; and (5) BPA Preferred Alternative would offer the same measures as the Proposed Action and include mitigations similar to Mitigation-By-Action No. 3 (radon monitoring) and No. 4 (providing an indoor air quality informational booklet.

48520 (DOE/EIS—0095F-Vol.2) **Expanded residential weatherization program. Final environmental impact statement. Volume II.** Aug 1984. 245p. (DOE/BP—264-Vol.2). NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE84016330.

Comments, responses, and letters submitted in response to the draft EIS are presented. Topics covered include the environmental process, decision recommendations, indoor/outdoor air quality, health effects, energy, cost, program, assumptions and format of EIS, mitigation, and other. (ACR)

48521 (NP—4901544) **Proposed Gulf of Alaska/Cook Inlet Lease Sale 88. Volume 1. Final environmental impact statement.** Jul 1984. 623p. NTIS, PC A99/MF A01. File Number TI84901544.

This environmental impact statement (EIS) discusses a proposal for oil-and-gas leasing in the Gulf of Alaska/Cook Inlet, alternatives to the proposal, major issues determined through the scoping process and through staff analyses, and potential mitigating measures. The proposal consists of 4796 blocks (10.40 million hectares; approximately 25 million acres) to be offered for lease in the Gulf of Alaska/Cook Inlet. Most of the lease area lies shoreward of the 2000-meter isobath. The potential effects of this leasing proposal are based in part on the assumption that the mean-resource estimates of 120 million barrels of oil in Cook Inlet/Shelikof Strait and 530 million barrels of oil in the Gulf of Alaska would be discovered and produced. For this amount of oil, 1.41 oil spills of 1000 barrels or greater are projected statistically over the 25-year life of the proposal. For this proposal, there is no higher than an 8% chance that one or more spills of 1000 barrels or greater would occur and contact land. The risks from spills would be mitigated to the extent that weathering and decay of oil occurs at sea and by the success of any spill countermeasures which would be attempted.

55 BIOMEDICAL SCIENCES, BASIC STUDIES

5502 Biochemistry

48522 (AD-A—141494/5) **Hormonal interference with pheromone systems in parasitic acarines, especially ixodid ticks. Annual technical report No. 4, 1 May 1983-30 April 1984.** Sonenshine, D.E.; Oliver, J.H. Jr.; Homsher, P.J. May 1984. 86p. NTIS, PC A05/MF A01.

Prepared in cooperation with Georgia Southern Coll., Statesboro, Dept. of Biology.

The most important result of recent project research was the demonstration of the juvenoid JH III by radioimmunoassay. This assay revealed an estimated 78 pg/tick in the hemolymph of partially fed Hyalomma dromedarii females, and an estimated 3 pg/tick in the hemolymph of partially fed D. variabilis. Other studies, especially digestion of tritium labelled JH III, provided additional evidence suggesting the presence of this hormone in adult ticks. The implications of these findings for our understanding of sex pheromone regulation in ticks is discussed. Other studies described in this report deal with the source of ecdysteroid in teh camel tick, Hyalomma dromedarii, the American dog tick, Dermacentor variabilis, and the soft tick, Ornithodoros parkeri. Studies done at ODU, using radioimmunoassay high performance liquid chromatography, and autoradiography, provide new evidence implicating the tick synganglion - lateral nerve plexus as an important site of ecdysteroid activity in the ixodid ticks. Other studies with ecdysteriods suggest that metabolism of ecdysone or 20-hydroxyecdysone (or both) to inactive metabolites, possibly including polar conjugates. If confirmed, these findings indicate the presence of only a single active ecdysteriod hormone in ticks, 20-hydroxyecdysone.

48523 (CONF-8405219—2) **Neutron diffraction of alpha, beta and gamma cyclodextrins: hydrogen bonding patterns.** Hingerty, B.; Betzel, C.; Saenger, W. (Oak Ridge National Lab., TN (USA); Freie Univ. Berlin (Germany, F.R.). Inst. fuer Kristallographie). 1984. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85001869.

From American Crystallographic Association meeting; Lexington, KY, USA (20 May 1984).

Cyclodextrins (CD's) have proved useful as model systems. They are torus-shaped molecules composed of six (α), seven (β) or eight (γ) (1 to 4) linked glucoses. In order to understand the hydrogen bonding in these enzyme models, neutron diffraction data were collected to unambiguously determine the hydrogen atom positions, which could not be done from x-ray diffraction data alone. α-CD has been shown to have two different structures with well-defined hydrogen bonds, one tense and the other relaxed. An induced-fit-like mechanism for α-CD complex formation has been proposed. Circular and infinite chain hydrogen bond networks have also been observed, which are energetically favored due to the cooperative effect. β-CD with a disordered water structure possesses an unusual flip-flop hydrogen bonding system of the type O-H . . . H-O representing an equilibrium between two states: O-H . . . O and O . . . H-O. γ-CD has now been studied at room temperature by neutron diffraction and also possesses the flip-flop hydrogen bond. Data have been collected to 0.62 A resolution at the ORNL reactor (HFIR). 235 atoms have been refined to $R=0.077$ for 4816 observed reflections ($I > \sigma$) and $R=0.099$ for all 5864 reflections. Low temperature neutron data will be collected. This study demonstrates that hydrogen bonds are operative in disordered systems and display dynamics even in the solid state. 17 references, 1 figure, 2 tables.

48524 **(DOE/ER/10903—1) Phytochrome from green plants: assay, purification and characterization. Progress report, June 1, 1981-May 30, 1982.** Quail, P.H. (Wisconsin Univ., Madison (USA)). Mar 1982. Contract AC02-81ER10903. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE82012903.

The new, microprocessor-based spectrophotometer designed by L.H. Pratt has been built, installed and tested as part of the collaboration between our laboratories. This instrument is substantially superior to previous designs. The use of polyethyleneimine (PEI) to precipitate chlorophyll from phytochrome-containing solutions has been investigated systematically. The phytochrome thus obtained has two properties which are different from that in etiolated tissue: (a) the peak position of Pr is almost 10 nm shorter (at 657 nm) than its etiolated counterpart; and (b) the molecule exhibits extremely rapid dark reversion. The critical ratio of chlorophyll/phytochrome above which spectral assay readings are distorted has been established in model experiments thus identifying the limits of the PEI procedure. Procedures for purifying the molecule from green tissue to homogeneity have been explored. Spectrally detectable phytochrome behaves somewhat differently on a variety of column chromatography media than it's etiolated counterpart, is not prominent as an ~ 120 k dalton polypeptide on SDS-PAGE and is not readily immunoprecipitated with anti-etiolated phytochrome. Whether these differences indicate that green tissue has an intrinsically different molecule or that in vitro modification of the molecule has occurred is yet to be determined. Axenic cultures of Mesotaenium have been prepared as a prelude to generating sufficient mass for algal phytochrome extraction. 1 reference.

48525 **(DOE/EV/01199—64, pp 45-74) Comparison of four methods of computing precipitation pH averages.** Stensland, G.J.; Bowersox, V.C. Sep 1984. NTIS, PC A16/MF A01. File Number TI84017449.

In Study of atmospheric pollution scavenging. Twentieth progress report.

Precipitation chemistry data for sites in the National Atmospheric Deposition Program (NADP) network were used to compare four methods of computing pH averages. From 15 to 140 weekly precipitation pH values were available for the 54 sites included in this study. The following four pH averages were examined: mean, median, sample volume weighted average pH, and the average pH calculated from the weighted average conservative ion concentrations. The weighted average pH varied from 4.10 for an Ohio site to 5.50 for an Oregon site and is the type of average generally reported in the literature. When the mean, median, or calculated average pH values were subtracted from the weighted average pH, the differences were from -0.05 to 0.27 for sites east of the Mississippi River. The differences frequently had larger magnitudes for sites west of the Mississippi River. In the extreme, for two Northern Great Plains sites with weighted average pH values of 5.11 and 5.21, the other three types of averages resulted in values that were 0.76 to 1.11 pH units higher. With such large differences at some sites, it is important to select the type of average most appropriate for the particular application being considered. 17 references, 12 figures, 6 tables.

48526 **Activation mechanism of rod outer segment cyclic GMP phosphodiesterase.** Yamazaki, A.; Stein, P.J.; Chernoff, N.; Bitensky, M.W. (Los Alamos National Lab., NM). *Journal of Biological Chemistry;* **258**: No. 13, 8188-8194(10 Jul 1983).

The physiological regulation of light-activated cyclic GMP phosphodiesterase in rod outer segments has been shown to depend upon a heat-stable inhibitor and upon the reversal of its effect by a specific GTP/GTP-binding protein complex.

5505 Metabolism

REFER ALSO TO CITATION(S) 55050048314

48527 **(CONF-8309272—1) Nutrient-enrichment of rhizosphere sediments: an experimental approach to the ecology of submersed macrovegetation.** Moeller, R.E. (Michigan State Univ., Hickory Corners (USA). W.K. Kellogg Biological Station). 1983. Contract AC02-76EV01599. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84016016.

From International symposium on aquatic macrophytes; Nijmegen, Netherlands (18 Sep 1983).

Three pilot studies have demonstrated that experiments involving fertilization of lake sediments effectively test whether growth of submersed, rooted macrophytes is limited by nutrients over periods of 1 or more months. Plant-food pellets (supplying salts of N, P, K, S, and Ca) inserted into the rhizosphere stimulated shoot production of: (1) Lobelia dortmanna, growing undisturbed in an unproductive softwater lake; (2) Scirpus subterminalis, extracted as cores of calcareous sediment from Lawrence Lake, Michigan, and grown in plastic pots maintained within the natural vegatation; and (3) Najas flexilis, transplanted as seedlings into small pots that exacerbated nutrient limitations. In the case of Lobelia and Scirpus, additional demographic study is needed to verify the significance of the demonstrated nutrient-limitations to the levels of biomass and productivity realized in nature. Photosynthesis of the nutrient-limited Najas could be stimulated 2 to 3 times when external concentrations of free CO2 were increased in short-term assays, but photosynthetic acclimation to ambient inorganic carbon concentrations apparently occurred during longer term growth. 11 references, 2 figures, 1 table.

48528 **(INIS-mf—8803) Influencing the carbromal metabolism by means of alcohol. Animal experiments with ^{14}C-labelled carbromal on rats.** Moldenhauer, A. (Hamburg Univ. (Germany, F.R.). Fachbereich Medizin). 3 Mar 1981. 101p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE84780577.

The influence of alcohol on the distribution and metabolism of carbromal was investigated on rats using 14-C-labelled Carbromal. Over a period of 2 hours, the carbromal levels reached in the various organs were compared. The time span chosen was equal to the interval in which alcohol is resorbed, metabolized, and eliminated in rats. In all organs of the alcohol groups, the carbromal levels 30-90 minutes after the application of carbromal were higher by 30-60% than in the control groups. In a discussion, an increased intestinal resorption or a blocked decomposition of carbromal by alcohol were named as possible reasons. To control the carbromal metabolism while applying alcohol, a thin-layer chromotographic separation and detection of the 14-C-labelled substance by means of thin-layer-scanning was carried out after having gone through the biological material and extracted the pharmaceutical. An influence of alcohol on the carbromal metabolism was not detected; there were no significant differences in the metabolism with and without alcohol. It was not found out if the extraction method used has to be regarded as the cause of this finding.

5506 Medicine

REFER ALSO TO CITATION(S) 55060048352, 48401, 48793, 48795, 48796

48529 **(BNL—51730) Proceedings of the first international symposium on neutron capture therapy.** Fairchild, R.G.; Brownell, G.L. (eds.). (Brookhaven National Lab., Upton, NY (USA)). 1982. Contract AC02-76CH00016. 394p. (CONF-8310253—). NTIS, PC A17/MF A01; 1; GPO Dep. File Number DE84017247.

From Symposium on neutron capture therapy; Boston, MA, USA (12 Oct 1983).

This meeting was arranged jointly by MIT and BNL in order to illuminate progress in the synthesis and targeting of boron compounds and to evaluate and document progress in radiobiological and dosimetric aspects of neutron capture therapy. It is hoped that this meeting will facilitate transfer of information between groups working in these fields, and encourage synergistic collaboration.

48530 (CEA-CONF—7100) Time-of-flight positron emission tomography and associated detectors. Vacher, J.; Allemand, R.; Campagnolo, R. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). Apr 1983. 1p. (In French). (CONF-8304181—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE84751756.

From Seminar on fast scintillation phosphors; Bruyeres-la-Chatel, France (19 Apr 1983).

An analysis of the timing capabilities of the detectors (scintillators and photomultipliers) in time-of-flight positron emission tomography is presented. The advantages of BaF_2 compared with CsF for the future tomographs are evaluated.

48531 (CEA-CONF—7103) Time-of-flight position emission tomography: new technological prospects. Allemand, R.; Cormoreche, E.; Gariod, R. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). Apr 1983. 13p. (In French). (CONF-8304182—2). NTIS (US Sales Only), PC A02/MF A01. File Number DE84751758.

From 2. international symposium on the basis of new techniques in medicine; Liege, Belgium (15 Apr 1983).

At the present time, the spatial resolution of time-of-flight positron emission tomography is limited as compared with conventional positron emission tomography. To improve this characteristic, new geometrical positions between scintillators and photomultipliers were studied, keeping the same or even improving the temporal resolution. The method consists of detecting separately time data and positional data.

48532 (CEA-CONF—7104) Principles of time-of-flight tomography. Campagnolo, R.; Garderet, P.; Lecomte, J.L.; Bouvier, A.; Darier, P.; Soussaline, F. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France); CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Mar 1983. 14p. (In French). (CONF-8304182—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE84751757.

From 2. international symposium on the basis of new techniques in medicine; Liege, Belgium (15 Apr 1983).

After a short introduction to the physics of time-of-flight positron tomography, the various aspects of this technique are presented. The characteristics including data acquisition and image reconstruction system of a positron tomograph (TTV01) which uses time-of-flight information, are described. The preliminary results obtained with TTV01, such as resolution and sensitivity, as well as phantom images, are presented.

48533 (CNEA—406) Quantitative determination of blood losses by a whole-body counter. Rochna Viola, E.M.; de Garreta, A.C.; Soria, N.; Blanco, E. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1976. 10p. (In Spanish). NTIS (US Sales Only), PC A02/MF A01. File Number DE84901964.

A method to quantitate blood losses by determination of the ^{51}Cr whole body retention (WBR) was developed. Autologous red cells labelled with Na_2O_4 ^{51}Cr were given intravenously. Blood losses were simulated by withdrawing blood samples. Percent relative variation (PRV) between real blood losses (blood withdrawal) and blood losses calculated by determining the WBR, were found. Withdrawal of 60 ml blood gave a PRV lower than 10.0%. ^{51}Cr body loss due to elution and red cell death was found to be 0.017 day^{-1}. The method allows the accurate detection of total blood losses of 60 ml or more, and it can be used to quantitate gastrointestinal or gynecological haemorrhages, avoiding the inconveniences involved by the complete recollection of faeces or of towels and tampons. 9 references, 1 figure, 1 table.

48534 (DOE/EV/04268—T3) Biomedical research with cyclotron produced radionuclides. Progress report, August 1, 1983-July 31, 1984. Laughlin, J.S.; Benua, R.S.; Gelbard, A.S.; Bigler, R.E. (Sloan-Kettering Inst. for Cancer Research, New York (USA)). 31 Aug 1984. Contract AC02-77EV04268. 62p. NTIS, PC A04/MF A01; GPO Dep. File Number DE84017340.

Progress is reported in the following areas: (1) preliminary evaluation of tumor localization of N-13 labeled L-amino acids; (2) evaluation of N-13 labeled amino acids and ammonia for physiological studies in patients undergoing chemotherapy for colorectal hepatic metastases; (3) evaluation of C-11 labeled alpha-aminoisobutyric acid (AIB) in patients with prostate cancer; (4) biological studies with N-13 labeled metabolites; (5) amino acid transport studies with synthetic C-11 labeled amino acids; (6) development of an imaging technique for measurement of regional perfusion; (7) carbon-11 labeled thymidine for tumor imaging and metabolic studies; (8) enzymatic synthesis of metabolites labeled with N-13 and C-11; (9) organic synthesis of C-11 labeled amino acids; (10) the preparation of F-18 fluorinating agents; and (11) remotely controlled, semi-automatic preparation of N-13 ammonia. (ACR)

48535 (DOE/EV/10363—6) Synthesis of radioiodinated fatty acids for use in diagnostic nuclear medicine. Progress report, March 1, 1984-February 28, 1985. Kabalka, G.W. (Tennessee Univ., Knoxville (USA). Dept. of Chemistry). 1984. Contract AS05-80EV10363. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85000302.

Methods were developed to synthesize radioiodinated fatty acids and an iodovinyl derivative of 1-aminocyclobutane carboxylic acid. New methods were developed for introducing nitrogen and oxygen isotopes, bromine 77, fluorine 18, and carbon 11 into physiologically active materials. 22 references. (ACR)

48536 (HRP—0904924/8) Criteria and standards for radiation oncology facilities and services in Indiana. Dec 1979. 95p. NTIS, PC A05/MF A01.

Contents: General information; Criteria and standards for radiation oncology facilities and services.

48537 (INIS-BR—121, pp 85-99) Quality control in radiotherapy. Cecatti, E.R.; Almeida, C.E. de (Instituto de Radioprotecao e Dosimetria, Rio de Janeiro (Brazil)). 1983. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. File Number TI84780533. (CONF-8308170—).

From Meeting on medical physics in Rio de Janeiro; Rio de Janeiro, Brazil (25 Aug 1983).

The following topics are dealt with: incertitudes of a radiotherapic treatment; incertitudes associated to the patient and quality control tests.

48538 (INIS-BR—121, pp 100-106) Quality assurance in radiodiagnosis. Ghilardi Netto, T. (Sao Paulo Univ., Ribeirao Preto (Brazil). Faculdade de Filosofia, Ciencias e Letras; Sao Paulo Univ., Ribeirao Preto (Brazil). Faculdade de Medicina). 1983. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. File Number TI84780533. (CONF-8308170—).

From Meeting on medical physics in Rio de Janeiro; Rio de Janeiro, Brazil (25 Aug 1983).

The following topics are dealt with: 1) the importance of the application of a quality assurance program in radiodiagnosis, with its main consequences : improvement of imaging quality, reduction of the patient exposure rate, cost reduction and 2) how to introduce the quality assurance control in the radiodiagnostic area.

48539 (INIS-BR—121, pp 107-116) Quality control in nuclear medicine. Leme, P.R. (Hospital dos Servidores do Estado, Sao Paulo (Brazil)). 1983. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. File Number TI84780533. (CONF-8308170—).

From Meeting on medical physics in Rio de Janeiro; Rio de Janeiro, Brazil (25 Aug 1983).

The following topics are discussed: objectives of the quality control in nuclear medicine; the necessity of the quality control in nuclear medicine; guidelines and recommendations. An appendix is given concerning the guidelines for the quality control and instrumentation in nuclear medicine.

48540 (INIS-BR—121, pp 122) **Radiotherapeutic treatment of mammary fields.** Marques, K.; Mendonca, A.D.V. 1983. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. File Number TI84780533. (CONF-8308170—).

From Meeting on medical physics in Rio de Janeiro; Rio de Janeiro, Brazil (25 Aug 1983).

48541 (INIS-BR—121, pp 123) **Whole-body irradiation in leukemia.** Pizzatto, M.Z.; Pizzatto, L.P.; Mendonca, A.D.V. 1983. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. File Number TI84780533. (CONF-8308170—).

From Meeting on medical physics in Rio de Janeiro; Rio de Janeiro, Brazil (25 Aug 1983).

48542 (INIS-BR—121, pp 126) **Measurements of dose distribution in lens, gonads, thyroid and other organs in the diagnostic exam with computerized tomography.** Coelho, M.J.; Almeida, C.E. de; Bertelli Neto, L.; Rosa, L.A.R. da (Instituto de Radioprotecao e Dosimetria, Rio de Janeiro (Brazil)). 1983. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. File Number TI84780533. (CONF-8308170—).

From Meeting on medical physics in Rio de Janeiro; Rio de Janeiro, Brazil (25 Aug 1983).

48543 (INIS-BR—121, pp 127) **Postal system for the quality control of the development of intra-oral radiographies.** Bessa, S.; Peixoto, J.E.; Souza Ferreira, R. de (Instituto de Radioprotecao e Dosimetria, Rio de Janeiro (Brazil)). 1983. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. File Number TI84780533. (CONF-8308170—).

From Meeting on medical physics in Rio de Janeiro; Rio de Janeiro, Brazil (25 Aug 1983).

48544 (INIS-BR—121, pp 133) **Relevance of interface effects on the correction of radiotherapeutic planning for the presence of heterogeneities.** Freitas, Lea C. de (Hospital Santa Rita, Porto Alegre (Brazil)). 1983. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. File Number TI84780533. (CONF-8308170—).

From Meeting on medical physics in Rio de Janeiro; Rio de Janeiro, Brazil (25 Aug 1983).

48545 (INIS-BR—121, pp 134-135) **Utilization of a programmable calculator for dose calculations in radiotherapy.** Pereira Junior, P.P. 1983. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. File Number TI84780533. (CONF-8308170—).

From Meeting on medical physics in Rio de Janeiro; Rio de Janeiro, Brazil (25 Aug 1983).

48546 (INIS-mf—8793) **Surgical, radio and immunotherapy of syngeneic tumors in mice.** Engel, B. (Freie Univ. Berlin (Germany, F.R.). Fachbereich Zahn-, Mund- und Kieferheilkunde). 10 Jun 1982. 101p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE84780574.

In untreated DBA/2 and (57 Black 6 mice the growth of and formation of metastases by syngeneic tumors (L 1210, EL 4, P 815 respectively Lewis Lung) was tested to obtain hints regarding the subsequent treatment modalities. In summary it can be said that each tumor type has its specific behaviour as regards the formation of metastases. Tumor-carrying mice were then operated on respectively received radiotherapy at different lengths of time after the tumor cell transplantation. The results led to the conclusion that an early therapy increased the survival rates. These findings were taken as a basis for further experiments in which tumor-carrying mice were exclusively treated 24 hours after the tumor cell transplantation. It was found that tumor-carrying animals, as compared to untreated control animals, were cured by surgical measures. Radiotherapy was successful in cases of L 1210 and EL 4 tumors. Animals carrying P 815 and Lewis Lung tumors that were irradiated 24 hours after the tumor cell transplantation died of progressive tumor growth.

48547 (INIS-mf—8794) **Early post-traumatic epilepsy following serious craniocerebral trauma, with emphasis on EEG and CT findings. A contribution to pathogenesis of post-traumatic fits.** Goeller, T. (Frankfurt Univ. (Germany, F.R.). Fachbereich Humanmedizin). 28 Sep 1981. 62p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE84780584.

In the study on hand, eighty patients with craniocerebral trauma were regularly examined by EEG. Twenty-two of the patients had clinically observable fits. In five other patients, only the EEG revealed paroxysmal events in the first week following trauma. In six patients who were observed to have fits, no corresponding EEG equivalent could be recorded for technical reasons. In case of early epileptical fits, CT always revealed an intercranial hemorrhage, except for two cases, the findings being in agreement with the lateral location of the focus as determined by EEG. The seriousness of cranial injury was directly related to the number of fits observed in the first post-traumatic week. Patients over thirty showed an increase of early post-traumatic fits. The lethality of patients with early fits was significantly increased as compared with patients without early fits. EEG examination as early as possible after the craniocerebral trauma is necessary and useful, both for detection of lesions and for appropriate drug therapy.

48548 (INIS-mf—8800) **Contribution of X-ray screening to radiation exposure of patients.** Bregulla, C. (Erlangen-Nuernberg Univ., Erlangen (Germany, F.R.). Medizinische Fakultaet). 12 Jul 1982. 78p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE84780581.

Radiation exposure caused by screening of the gastro-intestinal tract, oral examination of the gall and contrast medium enema into the colon was found to be caused by radiation exposure of foil film pictures. Thus the population exposure during these examinations can be stated more exactly. In 4 hospitals, the examination data pertaining to 56 patients with diseases of the gasto-intestinal tract, 16 patients with enemas of contrast media into the colon, and 7 patients with gall diseases were recorded with the surface dose monitor Diamentor D made by OTW, Freiburg. The surface dose on the patients was calculated from the available data and is in good agreement with the values stated in literature.

48549 (INIS-mf—8804) **Clinical value of angiography in diseases of the epigastric organs.** Mertens, A.W. (Technische Hochschule Aachen (Germany, F.R.). Medizinische Fakultaet). 23 Jul 1981. 105p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE84780585.

76 cases in which in the time between 1969 and 1974 coeliacographies were carried out and the diagnoses are clinically manifested were retrospectively analysed. The angiographic symptoms and the diagnostic results are compared to the literature. Following this, the diagnostic and therapeutic value in liver processes, pancreas processes, stomach tumours, gastrointestinal bleedings, traumas of the epigastric organs, catheter embolisation and stopping of acute, severe gastrointestinal bleedings are discussed. The value of angiography in comparison to laparoscopy, ERCP, sonography, and computerized tomography is discussed. At the end, the indication of angiography in diseases of the epigastric organs is summarized in two tables, distinguishing between absolute, relative, strongly restricted indications and no indication at all.

48550 (INIS-mf—8805) **Examinations with computerized cranial axial tomography carried out on patients with epileptic seizures, taking into consideration the EEG and the clinical picture.** Geiser, R. (Wuerzburg Univ. (Germany, F.R.). Medizinische Fakultaet). 19 Feb 1982. 80p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE84780586.

204 patients suffering from epileptic seizures were examined with the help of computerized cranial X-ray tomography; the results were compared with anamnestic, clinical, and EEC-findings. In good agreement with results published in literature, in 54% of the patients pathologic CT's such as tumours, attack scars, changes in ventricles and arachnoid spaces etc. were found. A pathological CT is very likely to appear in male patients who are 30 or even 50 years of age, having partial attacks with elementary symptoms,

focal diagnosis in the EEG and a neurological unilateral finding. Especially noteworthy is the tumour detecting rate achieved by CT and the fact that in nearly 5% of the cases CT detected a cerebral lesion which has not been suspected, neither clinically nor in the EEG (4 tumours). This shows clearly that CT represents a highly valuable diagnostic help, especially for patients with epileptic seizures.

48551 (INIS-mf—8808) **X-ray examination of functional disturbances in patients with parodontopathies.** Bimmerle, T. (Erlangen-Nuernberg Univ., Erlangen (Germany, F.R.). Medizinische Fakultaet). 5 Oct 1981. 60p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE84780587.

In a clinical investigation covering 42 patients with parodontopathy and a control group of 14 persons, a clinical and instrumental functional analysis was carried out. The clinical functional analysis was carried out using the Krogh-Poulsen method. For the instrumental functional analysis, the author used the evaluation in a Stuart-articulator after a Stuart-Pantography. On the majority of the patients examined, a plaque test according to Quigley-Hein was carried out additionally. When establishing the findings of the clinical status of the disease, the German Parodontal Status was taken into consideration. We proved with the help of correlation calculations that bone decomposition in two neighbouring teeth is not independent of each other. Therefore, the individual teeth could not be compared with one another as regards their malocclusions. When comparing to results obtained by other authors, however, the author observed that malocclusions have an influence on bone decomposition. They must be eliminated within the framework of a parodontosis treatment.

48552 (INIS-mf—8810) **Estimation of the radiation dose in radioiodine therapy for eliminating the thyroid, the primary tumour, or its metastases.** Pithamitsis, A. (Muenchen Univ. (Germany, F.R.). Fakultaet fuer Medizin). 8 Oct 1981. 65p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE84780582.

The conditions of eliminating residual thyroid tissue and metastatic tissue by means of a radioiodine therapy were investigated with the objective of defining the estimated radiation dose accurately. The volume and weight of the residual thyroid tissue and the metastatic tissue were calculated using the values obtained from scintiscans and on the basis of ellipsoid models. The biological half-life during therapy was determined by means of a dose rate meter. It was seen that the half-life during therapy is 2-3 days and is shorter than the half-life determined in the ^{131}-iodine test (4-5 days). 203 patients were treated with ^{131}-iodine; in 62.7%, the residual thyroid was eliminated, in 30.7%, the elimination was incomplete and in 6.6% there was no visible success. After radiation doses of 130.000 rad (1300 Gy), all metastases were eliminated, after a dose of 1,000-1,300 Gy only 76%. The activity for the therapy should be calculated on the basis of a short effective half-life of 2-3 days. The dose has to be as high as possible (60 to 100 Gy), always taking whole-body exposure into consideration. (orig./MG).

48553 (INIS-mf—8811) **Standardization of lesions of external bone ligaments.** Ryll, H. (Freie Univ. Berlin (Germany, F.R.). Medizinische Fakultaet). 24 Nov 1981. 56p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE84780588.

In the time from March 1978 until September 1978, 100 patients having a lesion of the capsular ligament at the upper ankle joint immediately after an accident were examined. The manual X-ray diagnosis was compared with a diagnosis using a newly-created holding apparatus. This way of diagnosing was carried out at the same time on the same patient; this gave an optimal possibility of comparing the two ways of examination. Generally seen, apparative X-ray diagnosis achieved higher values thus giving the possibility of more exact classification as to the diagnosis and therapy.

48554 (INIS-mf—8854) **Comparative X-ray investigation of lateral and anterior-posterior ankle-joint images - comparison with pathological and anatomical findings concerning lateral ankle-joint lesions and their clinical importance, studied in a special type of holding device.** John, F. (Freie Univ. Berlin (Germany, F.R.). Medizinische Fakultaet). 4 Mar 1982. 88p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE84780590.

The study reports on a possibility to interpret the relation of the different bone structures of the upper ankle-joint to one another in the X-ray picture without using contrast media. Modern functional diagnostic methods increasingly make use of X-ray pictures taken in fixed position. It seems useful to standardize such X-ray images of the ankle-joint in order to make them reproducible. The author developed a device that would suit these purposes. A diagnosis required the reproduction of the accidental mechanism. The clinical symptoms do not permit to clearly state the extent of the lesion of the ligaments. The results of the post-operative follow-up examinations confirm the urgent necessity of the standardized diagnostic method presented and the success of the therapy applied. The presented X-ray method permits safe diagnosis of ruptures of the ligaments. Location of a certain rupture is not possible with the fixed-position X-ray screening. For a clear assessment of lesions of the ligaments at the lateral ankle-joint, X-ray pictures must be taken both in the anterior-posterior path of rays and in the lateral one. A normal result in the lateral path of rays does not exclude a pathologic result in the anterior-posterior path of rays, and vice versa.

48555 (INIS-mf—8856) **Computers in cardiology.** (Institute of Electrical and Electronics Engineers, Inc., New York (USA); Technische Hochschule Aachen (Germany, F.R.)). 1983. 180p. NTIS (US Sales Only), PC A09/MF A01. File Number DE84780591.

The present abstract book contains the abstracts of 90 lectures and 29 posters presented at the conference. They are dealing with the following themes: Echocardiography, databases, ECG interpretation, wall motion, arrhythmia processing systems, electrophysiological models, ECG-mapping, intensive care and hemodynamic monitoring, digital subtraction angiography, clinical electrophysiology, mechanical properties of the cardiovascular system, coronary artery measurements, arrythmia analysis, arrhytmia monitoring techniques, ECG waveform recognition and nuclear cardiology.

48556 (INIS-mf—8860) **Comparative X-ray studies on the behaviour of amalgam and gold fillings at the margins in the approximal space as a function of time of residence.** Hansen, R. (Muenchen Univ. (Germany, F.R.). Fachbereich Medizin). 8 Apr 1982. 62p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE84780592.

Within the framework of this thesis, X-ray pictures have been made of 430 gold or amalgam fillings in order to measure the gap between approximal cavity margin and filling margin. With amalgam fillings, the gap width measured after a residence time of half a year was 9.3 μm and widened to 136.9 μm after 8 years, which represents an increase to the 14-fold. The gap widths measured with gold inlays only doubled within this period, increasing from 38.8 μm after half a year to 77.4 μm after 8 years. The number of retention spots found in the approximal-cervical space with amalgam fillings was at least twice that found for gold fillings. From this it is concluded that gold inlays are by far the better solution for dental restorations.

48557 (INIS-mf—9049) **Determination of phospholipid transfer proteins in rat tissues by immunoassays.** Teerlink, T. (Rijksuniversiteit Utrecht (Netherlands)). 26 Sep 1983. 103p. NTIS (US Sales Only), PC A06/MF A01. File Number DE84780579.

Several quantitative immunoassays have been developed for two phospholipid transfer proteins from rat liver, i.e. the phosphatidylcholine transfer protein and the non-specific lipid transfer protein. The development of a double-antibody radioimmunoassay for the phosphatidylcholine transfer protein is described. The transfer protein was labelled with iodine-125 by the mild glucose oxidase-lactoperoxidase method. Although less than one tyrosine residue per molecule of transfer protein was labelled, only 20% of the labelled transfer protein was immunoprecipitable. This value could be increased to 80% by purifying the labelled protein by affinity chromatography on a column of anti-phosphatidylcholine transfer protein-IgG coupled to Sepharose 4B. The radioimmunoassay was used to determine the levels of phosphatidylcholine transfer protein in homogenates and 105 000 xg supernatants from various rat tissues as well as several Morris hepatomas. An enzyme immunoassay for the non-specific lipid transfer protein is also described. The antiserum that was raised especially by the author was cross-reactive with the non-specific lipid transfer protein present in 105 000 xg supernatants from human, mouse and bovine liver. The non-specific lipid transfer protein lost its immunoreactivity upon labelling with iodine-125 using different labelling techniques. Therefore, a regular radioimmunoassay could not be developed. The results of these different assays were compared.

48558 Neutron kerma values above 15 MeV calculated with a nuclear model applicable to light nuclei. Brenner, D. (Los Alamos National Lab., NM (USA)). *Physics in Medicine and Biology;* **29**: No. 4, 437-441(Apr 1984).

The author's group has developed a model, applicable to low-mass nuclei, in which experimental nuclear structure information (energy, spin, isospin and parity of nuclear levels, spectroscopic factors for multi-nucleon clustering, etc.) is explicitly included. Comparisons with several recent sets of experimental results indicate confidence in use of the model. Kerma values were calculated for carbon, nitrogen and oxygen at 18 energy points between 16 and 80 MeV, and it was noted that they could be fitted to a simple functional form with errors of no more than 1% at any point. The differences between this calculation and others are clearly significant, and ultimately result in significant uncertainties in the calculated absorbed dose delivered during high energy neutron radiotherapy.

5507 Microbiology

REFER ALSO TO CITATION(S) 55070048219

5509 Pathology

48559 (INIS-mf—8790) Ossification of the tracheal cartilages. Radiology and morphometry. Rudolf, L. (Erlangen-Nuernberg Univ., Erlangen (Germany, F.R.). Medizinische Fakultaet). 11 Feb 1980. 49p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE84780583.

Radiological studies of tracheal ossification were carried out in 104 male and female corpses who had died at 14 to 92 years of age. The structural changes of the tracheal cartilages were related to their cross sections, determined in defined points by morphometric methods.

48560 (INIS-mf—8802) In vivo measurement of the cell decay rate in rabbit skin after labelling with 5[^{125}I]Iodo-2′-desoxyuridine. A model to define experimental skin burns. Schubert, R. (Tuebingen Univ. (Germany, F.R.). Fakultaet fuer Chemie und Pharmazie). 20 Nov 1981. 74p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE84780576.

The paper refers to a method developed to measure the decay rate of skin cells in vivo. After injecting 70 μci ^{125}IUdR in 50 μl tyrode solution, the cell decay rate of differentiated hair follicle and epidermis cells is reflected with a high accuracy by the reduction of the γ-activity between the 2nd and 5th day of the labelling which can be measured extracorporally. The half-life of the decay of differentiated skin cells lies, in rabbits, appr. between 40 and 80 h, is however very constant as regards the individual animal. The applicability of the method of determining the course and the extent of a skin damage was demonstrated in skin burns of the 1st and 2nd degree. Even a small skin damage similar to a sunburn caused 10% of the skin cells to die within 24 h. A second-degree burn on the surface which was completely healed without leaving any scars after 2 weeks more than half of the cells of the skin area concerned died within 4 h after the burn and another 10% during the next 8 h, despite a strongly disturbed blood circulation and a strong disturbance of the micro circulation of the tissue fluid due to the formation of skin oedemas dissolved cell nucleus material was quickly transported out of the skin. Additional autoradiographic examinations revealed that primarily epidermis and hair follicle cells were damaged while, for example, connective tissue cells of the skin have survived the burn considerably better.

5510 Physiological Systems

REFER ALSO TO CITATION(S) 55100048577

48561 (CONF-680444—2) Effects of physical activity on bone. Smith, E.L. Jr.; Felts, W.J.L. (Minnesota Univ., Minneapolis (USA)). Jul 1968. 18p. (COO—1422-33). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84017611.

From Symposium on skeletal mineralization; Detroit, MI, USA (24 Apr 1968).

Fifty Swiss Albino mice were used in this investigation. Thirty animals were run on a motor-driven treadmill at 0.5 miles per hour for five minutes twice daily for twelve weeks. The exercise group showed an increased fracture-load of the femur and increase in the organic and inorganic components of the bones as compared to the control group. 16 references, 1 figure, 5 tables.

48562 (INIS-mf—8807) Fast axonal transport of 3H-leucin-labelled proteins in the unhurt and isolated optical nerve of rats. Wagner, H.E. (Tuebingen Univ. (Germany, F.R.). Medizinische Fakultaet). 1981. 84p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE84780578.

The distribution of radioactivity of amino acid molecules incorporated in protein after injection of ^{3}H-Leucin into the right bulb was investigated and determined along optical nerve after 1, 2, and 4 h. A slightly increased radioactivity at the point of entrance of the optical nerves into the optical duct was found. A slightly reduced axon diameter was discussed as a possible cause. The radioactivity brought into the optical nerve via the vascular system was determined by measuring the contralateral optical nerve. In relation to the axonally transported activity, it was low. The speed of the fast axonal transport is 168 mm/d. If the processes ruling the amino acids in the perikaryon are taken into consideration, the transport speed is 240 mm/d. The application of the protein synthesis prohibitor, Cycloheximide, 5 minutes after the injection of Leucinin completely prevented the appearance of axonally transported labelled proteins. When cycloheximide was administered 2 h after Leucin, a significantly lower radioactivity than in the nerve could be determined after another 2 h; i.e. the incorporation of Leucin was not completed yet after 2 h. The profile of active compounds was the same as in the control group. In other experiments, the axonal transport of labelled proteins in isolated optical nerve fibres was tested. If the separation was carried out 2 h after the injection of Leucin an extreme reduction in activity could be determined after 1 or 2 h. The continued distribution of activity after cycloheximide treatment and removal of perikarya in comparison with the control indicate the continuation of the transport, also after separation of the axon from the perikaryon. This means that, during the time of the experiment, the mechanism of the fast axonal transport functions independently of the perikaryon.

5530 Agriculture And Food Technology

REFER ALSO TO CITATION(S) 55300047738

48563 (AD-A—142222/9) Aquatic Plant Control Research Program. Field methods to measure aquatic plant treatment method efficacy. Final report. Killgore, K.J.; Payne, B.S. Apr 1984. 32p. NTIS, PC A03/MF A01.

The Aquatic Plant Control Research Program (APCRP) of the U.S. Army Engineer Waterways Experiment Station (WES) is developing field techniques to measure treatment efficacy and to determine site characteristics that influence the treatment efficacy. Treatment efficacy is considered a quantitative determination of the extent and duration of changes in problem aquatic plant populations attributable to the use of a treatment method (i.e., chemical, mechanical, biological, environmental). Depending on the plant species, efficacy can be determined or indicated by changes in biomass, areal distribution, or height of an aquatic plant in response to treatment. Aquatic plant biomass is sampled with a WES aquatic biomass sampler; areal distribution of aquatic plants is determined by aerial photography or with an electronic positioning system; and submersed aquatic plant height is measured with a fathometer (depth recorder) used with an electronic positioning and repositioning system (AGNAV). The APCRP has also developed field techniques to determine site characteristics that influence efficacy using commercially available instrumentation. This instrumentation can be used to measure treatment efficacy and to determine site characteristics simultaneously.

48564 (PB—84-209394) **Comparison of equations used for estimating agricultural crop evapotranspiration with field research.** Hill, R.W.; Johns, E.L.; Frevert, D.K. Oct 1983. 261p. NTIS, PC A12/MF A01.

Prepared in cooperation with Utah State Univ., Logan, Dept. of Agricultural and Irrigation Engineering.

Research data on alfalfa water use and related yields were obtained for 10 sites in the Western United States. Similar research data was obtained for corn at eight sites. Four different types of research studies were available: lysimeter, line source sprinkler, stress plots, and farm yield. Research alfalfa yields and corresponding ET (evapotranspiration) were assumed to be 20 percent greater than field attained yields and ET, based on experience. Similarly, corn research yields and ET were assumed to be 10 percent greater than field attained yields and ET. Yield versus ET relationships were derived from the available research data.

48565 (TVA/PUB—84/78) **Vector control activities, fiscal year 1983.** Pickard, E.; Cooney, J.C.; McDuff, B.R. Jul 1984. 21p. NTIS, PC A02/MF A01. File Number DE85900076.

The goal of the Vector Control Program is to safeguard public health and well-being in the Tennessee Valley region by controlling arthropod pests of medical importance that are propagated on TVA lands or waters or that are produced as a result of TVA activities. To achieve this goal the program is divided into two major categories consisting of operations and support studies. The latter is geared to improving the operational effectiveness and efficiency of the control program and to identify additional vector control problems requiring TVA attention and study. Nonchemical methods of control are emphasized and are supplemented with chemical measures as needed.

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

REFER ALSO TO CITATION(S) 56012048270

48566 (AD-A—141515/7) **Effects of ionizing radiation and restraint stress on activity, avoidance conditioning, and stomach ulcers in albino rats. Final report October 1980-December 1981.** Lanum, J.; Blick, D.W.; Campbell, M.E.; Wheeler, T.G.; Koger, S.A. (Systems Research Labs., Inc., Dayton, OH (USA)). Mar 1984. 33p. NTIS, PC A03/MF A01.

In an experiment with albino rats, we have tried to model a nuclear attack scenario in which military personnel receiving 600 to 800 rads of ionizing radiation would be making a counterattack under the stress of an emergency situation. We used a dose of radiation that, though higher than the human exposure field, was estimated to be its physiological equivalent. Restraining the rat in an immobile position, a technique previously shown to have stressing qualities for rats, was chosen as an analogy to the stress of being in a war emergency. Activity and conditioned avoidance acquisition were chosen as test responses. Performance in the activity maze was affected only to a minor degree and in the direction of considering irradiation as activating. However, all irradiated groups showed retarded conditioned avoidance acquisition, which can be interpreted as decreased adaptability to a stressful situation. Further, our results support the expectation of performance decrements in the military scenario that could not be predicted by considering ionizing radiation in isolation. On the avoidance task, male rats in the combination stress-irradiation condition showed more failures to respond and longer response latencies than any other group. Female rats, on the other hand, showed shorter escape/avoidance latencies in the combined stress-irradiation condition than in the irradiation condition alone. This sex difference may be useful as a clue for investigating mechanisms of radiation resistance and interactions between stressors.

48567 (AD-A—142289/8) **Delayed effects of proton irradiation in Macaca mulatta. III. Glucose intolerance. Interim report 1964-1983.** Salmon, Y.L.; Yochmowitz, M.G.; Wood, D.H. (School of Aerospace Medicine, Brooks AFB, TX (USA)). Mar 1984. 28p. NTIS, PC A03/MF A01.

A group of rhesus monkeys is being studied in a lifetime survey of the delayed effects of proton irradiation. The animals were exposed during the period 1964 - 1969 to single total-body doses of protons covering the spectrum of energies and total doses that might be expected to occur in space during a major solar flare event. This report describes the results of intravenous glucose tolerance test and the insulin response to glucose challenge in 106 irradiated animals, their control group of 42, and 10 younger control animals. The results indicate that the clearance rate of blood glucose is influenced by the age of the animal and by the type and energy of the radiation. Animals receiving greater than 360 rads of proton irradiation of energies above 138 MeV had significantly slower glucose clearance than nonirradiated controls. Seventeen-twenty-year-old controls were less glucose tolerant than 9-11-year-old controls. Animals with normal glucose tolerance showed considerable individual variation in insulin response, while in animals with marked glucose intolerance (clearance rate < 1.0 %/min), low insulin response was a consistent finding.

48568 (DOE/ER/60118—2) **Confirmation of selected milk and meat radionuclide transfer coefficients. Progress report.** Ward, G.M.; Johnson, J.E. (Colorado State Univ., Fort Collins (USA)). 28 Aug 1984. Contract AC02-83ER60118. 25p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84016848.

The objectives are to determine transfer coefficients to milk, beef and chicken of four radionuclides for which transfer coefficients were either indetermined or based upon secondary data. The radionuclides are ^{99}Mo, ^{99}Tc, ^{140}Ba, and ^{131}Te. The transfer coefficient for ^{133}I to eggs was also determined, because again only limited data was available in the literature.

48569 (INIS-BR—121, pp 124) **Nuclear accidents: dosimetric - and medical aspects.** Oliveira, A.R. de (NUCLEBRAS, Rio de Janeiro (Brazil)). 1983. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. File Number TI84780533. (CONF-8308170—).

From Meeting on medical physics in Rio de Janeiro; Rio de Janeiro, Brazil (25 Aug 1983).

48570 (INIS-mf—8836, pp 177-185) **Chemiluminescence in peripheral leukocytes of mice following sublethal X-ray irradiation.** Fischer, H.; Hovestadt, I. (Max-Planck-Institut fuer Immunbiologie, Freiburg im Breisgau (Germany, F.R.)); Moenig, H. (Freiburg Univ. (Germany, F.R.). Inst. fuer Biophysik und Strahlenbiologie). 1982. (In German). NTIS (US Sales Only), PC A11/MF A01. File Number TI84780575. (CONF-8205271—).

From 31. annual meeting of the Civil Defense Commission of the Federal Minister of the Interior; Trier, F.R. Germany (1 May 1982).

The studies on CL in whole blood had the following results: 1. CL is measurable in whole blood of mice although the value are five times lower than in human blood. 2. Increased granulocyte CL is observed after whole-body irradiation with doses up to 100 R. The stimulation can be observed already 1 or 2 days p.i. By combining blood count and CL, two radiation-influenced parameters can be correlated in order to increase the sensitivity of the method.

3. Whole-blood CL is also a valuable method to study the effects of radioprotective agents in the low-dose range. (orig.).

48571 (INIS-mf—8978, pp 128) **Diffuse and colony-type hemopoiesis after total body irradiation in the mouse spleen.** Mozsa, S. (Semmelweis Orvostudomanyi Egyetem, Budapest (Hungary). Radiologiai Klinika). 1981. NTIS (US Sales Only), PC A10/MF A01. File Number TI84780385. (CONF-8109254—Absts.).

From 5. Czechoslovak radiological congress; Bratislava, Czechoslovakia (2 Sep 1981).

48572 (INIS-mf—9040, pp 342) **Hazards from radioactive waste in perspective.** Cohen, B.L. (Pittsburgh Univ., PA (USA)). 1982. NTIS (US Sales Only), PC A15/MF A01. File Number TI84780568. (CONF-820933—Summs.).

From International conference on radioactive waste management; Winnipeg, Manitoba, Canada (12 Sep 1982).

48573 (INIS-mf—9053, pp 34-40) **Development in health monitoring for radiological work.** Zuidema, H. (Philips Gloeilampenfabrieken N.V., Eindhoven (Netherlands). Medische Dienst). 1982. (In Dutch). NTIS (US Sales Only), PC A05/MF A01. File Number TI85780001. (CONF-820199—).

From Occupational health aspects of ionising radiation meeting; Amsterdam, Netherlands (6 Jan 1982).

A state-of-the-art review is presented of the radiation protection institute serving all the company's establishments throughout the country, of the Philips corporation in Eindhoven (NL). A list of health monitoring tasks was developed, as well as a classification of types of radiological work. The thermoluminescent dosemeter in form of a badge was the control medium of choice. Results and findings of medical inspections are discussed.

48574 (INIS-mf—9053, pp 49-51) **Application of ionizing radiations in metal works. Experiences in the field of occupational health.** Lagerweij, J. (Stichting Bedrijfsgezondheidsdienst, Utrecht (Netherlands)). 1982. (In Dutch). NTIS (US Sales Only), PC A05/MF A01. File Number TI85780001. (CONF-820199—).

From Occupational health aspects of ionising radiation meeting; Amsterdam, Netherlands (6 Jan 1982).

The author relates some experiences with radiation accidents in big steel plants where X-ray radiography is used for inspection of welded products. He also reports on personnel monitoring of travelling workers who do repairs to different nuclear power plants.

48575 **Sister chromatid exchanges in bone marrow cells of mice maintained on tritiated water.** Ikushima, T. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.); Benz, R.D.; Carsten, A.L. (Brookhaven National Lab., Upton, NY (USA)). *International Journal of Radiation Biology and Related Studies in Physics, Chemistry and Medicine;* **45**: No. 3, 251-256(Mar 1984).

The ability of tritium to induce sister chromatid exchanges (SCEs) has been investigated in male mice of the Hale-Stoner-Brookhaven strain maintained on drinking water containing 3.0 μCi/ml tritiated water (HTO). At selected intervals after 28-261 days of consuming HTO, the frequency of SCEs and the kinetics of cellular proliferation were measured in bone marrow cells of animals maintained on HTO, and in age-matched control groups, by 5-bromo-2'-deoxyuridine labelling methods. A statistically significant (1 percent level) elevation of SCEs was observed after 81, 163, 192, 247 and 261 days of HTO ingestion. The frequency of induced SCEs increased linearly with the ingestion time. These results are of particular interest since ionizing radiation is generally not considered to be an efficient inducer of SCEs.

5603 Chemicals Metabolism And Toxicity

REFER ALSO TO CITATION(S) 56030047344, 47418, 47418, 47439, 48473, 48479, 48527

48576 (BMI/ONWI—544) **Bibliography: salt impacts on vegetation and soils.** (NUS Corp., Gaithersburg, MD (USA)). Aug 1984. Contract AC06-76RL01830;AC02-83CH10140. 82p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85000384.

This report is a bibliography of literature addressing the impacts of salt on vegetation and soils. The titles in this listing were selecced from several computerized literature searches with the intent of identifying resources which may be used to assess the effects of salt deposition around a repository. There is a host of literature, but most of the studies are specific to the mechanism introducing the salt to the soil. This bibliography is organized around these mechanisms. The specific topics on salt impacts include studies on the Permian Basin; Chalk Point, MD, cooling tower; other cooling towers; modeling; highway deicing; and soil-water-vegetation systems.

48577 (DOE/EV/10729—1) **Sodium accumulation in Atriplex. Final report.** Norton, J.A.; Caldwell, M.M.; Richardson, S.G. (Utah State Univ., Logan (USA)). Sep 1984. Contract AC02-81EV10729. 123p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE84017282.

This study was undertaken to determine the ecological significance and the significance to arid land reclamation of sodium accumulation and nonaccumulation in Atriplex. There was a continuum in the genetic tendency of Atriplex canescens to accumulate sodium, from populations which accumulated almost no sodium to populations which accumulated up to 7% in the leaves. There were also substantial differences in sodium uptake between populations of A. tridentata, A. falcata and A. gardneri, with some populations having less than 0.1% leaf sodium and other populations having up to 5 or 6%. In three experiments (a field study, a greenhouse pot study and a hydroponics study) there were no significant differences in salinity tolerance between sodium accumulating and nonaccumulating A. canescens: both genotypes were highly salt tolerant. There was a significant buildup of sodium in the soil beneath sodium accumulating Atriplex plants, both in natural populations and on revegetated oil shale study plots. The sodium buildup was not sufficient to be detrimental to the growth or establishment of most herbaceous species, but with older Atriplex plants or with more saline soil, the buildup could potentially be detrimental. 14 references, 42 figures, 3 tables.

48578 (EPRI-EA—3672) **Development and validation of a terrestrial microcosm test system for assessing ecological effects of utility wastes. Final report.** Van Voris, P.; Tolle, D.A.; Arthur, M.F.; Chesson, J.; Zwick, T.C. (Battelle Columbus Labs., OH (USA)). Aug 1984. Contract AC06-76RL01830. 189p. NTIS, PC A09/MF A01; 1 - EPRI; GPO Dep. File Number DE85001913.

The primary emphasis in this program was to develop, test, and compare responses of plants grown on soil-core microcosms and similarly treated field plots to different treatment levels of fly ash over a period of two years. In addition, flower pot test systems, containing the same soil, crops, and fly ash treatments, were compared with the responses of the microcosms. This was done to determine the relative accuracy, variability and reliability of the two test systems when compared to the field plots. Comparisons of microcosms and flower pots for defining the effect of different treatment levels of fly ash on primary productivity in the field indicate that the microcosm is a more effective tool overall for forecasting phytotoxicity. Microcosms predicted element uptake in field-grown alfalfa as well as flower pots for the first growing season, but microcosms were better in predicting element uptake during the second growing season. Statistical analyses support the uses of the microcosms as a test device that could be used to develop the shape of the crop yield dose-response curves as well as to assess disruption of nutrient cycling processes and estimate potential for food chain transport of many of the elements found in utility wastes. It is hypothesized that combining test results from soil-core microcosms with single-species bioassays, chemically characterizing both the waste material and the local soil, and evaluating the phytotoxicity of the waste components to crops would strengthen the environmental risk assessment process. 92 references, 36 figures, 54 tables.

48579 (LMF—107, pp 305-316) **Life-span study of rodents inhaling diesel exhaust: results through 30 months.** Mauderly, J.L.; Benson, J.M.; Bice, D.E.; Carpenter, R.L.; Evans, M.J.; Henderson, R.F.; Jones, R.K.; McClellan, R.O.; Pickrell, J.A.; Redman, H.C. Dec 1983. NTIS, PC A21/MF A01. File Number TI84012996.

In Inhalation Toxicology Research Institute annual report, October 1, 1982-September 30, 1983.

A life-span study of rodents exposed by inhalation 7 h/day, 5 days/week to diluted diesel exhaust at particle concentrations of 7000, 3500, and 350 $\mu g/m^3$ continued to 24 months of exposure for mice and to 30 months of exposure for rats. Particle clearance was slowed and lung burdens of diesel particles continued to increase at the two higher levels. The particle accumulation was associated with lung inflammation, cell proliferation, epithelial metaplasia, and fibrosis, which was reflected by impairment of respiratory function. Immunological function in pulmonary lymph nodes was altered. Cytochrome P-450 levels in lung, altered at 12 months, were normal at later times. No adverse health effects were observed at the lowest exposure level. Examination of lungs for tumors is continuing.

48580 (LMF—107, pp 317-320) **Proliferative and morphological response of rat lungs and lung-associated lymph nodes to inhaled fly ash.** Shami, S.G.; Hahn, F.H. Dec 1983. NTIS, PC A21/MF A01. File Number TI84012996.

In Inhalation Toxicology Research Institute annual report, October 1, 1982-September 30, 1983.

Exposure of young adult Fischer-344 rats to inhaled fly ash for 4 weeks caused transient increases in proliferation of large airway epithelial cells, and alveolar interstitial cells; there was no effect on terminal bronchiolar epithelial cells. Transient morphological changes were associated with proliferative changes in the alveolar region only. There was a permanent increase in proliferation of cells in the paracortical region of the thoracic lymph nodes up to 26 weeks after exposure. Small granulomas were seen in the thoracic lymph nodes at 26 and 52 weeks. These data indicate that fly ash exposure may have affected thymus-dependent lymphocytes and, perhaps, cell-mediated immunity.

48581 (LMF—107, pp 321-324) **Testicular toxicity from subchronic inhalation exposure of Beagle dogs to 2,2,2-trifluoroethanol.** Marshall, T.C.; Hahn, F.F.; Hobbs, C.H. Dec 1983. NTIS, PC A21/MF A01. File Number TI84012996.

In Inhalation Toxicology Research Institute annual report, October 1, 1982-September 30, 1983.

A whole-body inhalation exposure of 12 Beagle dogs (four dogs/exposure level) to 2,2,2,-trifluoroethanol (TFE) was conducted for 6 h/day, 5 days/week for 8 weeks at 0, 100, and 400 mg TFE/m^3. Testicular atrophy was observed in TFE-exposed dogs, as evidenced by a decrease in testicle cross-sectional area. By the end of the exposure period, sperm viability in dogs at the lower TFE exposure level decreased significantly relative to control dogs. Dogs at the 400 mg/m^3 exposure level were azoospermic. These effects were resolved by 12 weeks after completion of the exposure. Two dogs from each exposure level were sacrificed immediately after the eight weeks exposure period; histological examination of tissues revealed dose-related testicular lesions. These were characterized by reduction in the thickness of the germinal epithelium and spermatid giant cell formation in dogs exposed to 100 mg TFE/m^3. A complete lack of maturing cells was noted at the high exposure level. These studies provide further evidence that TFE could be a testicular toxin when inhaled by humans.

48582 (LMF—107, pp 327-330) **Immune phagocytosis by canine pulmonary alveolar macrophages.** Harmsen, A.G.; Bice, D.E.; Muggenburg, B.A. Dec 1983. NTIS, PC A21/MF A01. File Number TI84012996.

In Inhalation Toxicology Research Institute annual report, October 1, 1982-September 30, 1983.

The deposition of a particulate antigen in the lungs of dogs causes the local accumulation of cytophilic antibody and opsonizing antibody. These antibodies greatly enhanced phagocytosis by pulmonary alveolar macrophages as shown by in vitro and in vivo experiments. It appears that these affects were due to local antibody-secreting cells. The local accumulation of antibody-secreting cells in the lung mediated immune phagocytosis and, thus, may play a critical role in pulmonary defense mechanisms.

48583 (LMF—107, pp 331-334) **Cell-mediated immunity of the dog lung.** Galvin, J.B.; Bice, D.E.; Muggenburg, B.A. Dec 1983. NTIS, PC A21/MF A01. File Number TI84012996.

In Inhalation Toxicology Research Institute annual report, October 1, 1982-September 30, 1983.

This study used the newly developed leukocyte procoagulant activity (LPCA) assay and the macrophage migration inhibition factor (MIF) assay to evaluate cell-mediated immunity serially in control and immunized lung lobes of dogs. A fiberoptic bronchoscope was used to immunize Beagle dogs with 10^{10} sheep red blood cells (SRBC) in the left cardiac lung lobe; the right cardiac lobe received saline as a control. The immune response as determined by the LPCA and MIF assay was evaluated in cells obtained serially from bronchial washings and blood from 5 to 21 days after immunization. The LPCA assay showed a peak response of similar magnitude in both the immunized and control lung lobes 9 to 12 days after immunization and had returned to normal by day 21. The MIF assay for both immunized and control lung lobes peaked from 9 to 14 days after immunization.

48584 (LMF—107, pp 335-338) **Effects of age on immune responses after localized lung immunization.** Bice, D.E.; Muggenburg, B.A. Dec 1983. NTIS, PC A21/MF A01. File Number TI84012996.

In Inhalation Toxicology Research Institute annual report, October 1, 1982-September 30, 1983.

Dogs 5 through 16 years of age were immunized by deposition of antigen in a single lung lobe. The number of lymphoid cells producing specific IgM antibody and the level of specific IgG antibody were measured in blood, as well as in the immunized and control lung lobes. Even though antibody-forming cells and specific antibody were found in the blood of older animals, most dogs over 7 years of age had significantly fewer antibody-forming cells and less specific IgG antibody in the immunized lung lobe than did younger animals. Changes necessary to recruit immune cells and antibody from the blood into the lung appeared to be reduced in dogs older than 7 years of age.

48585 (LMF—107, pp 339-342) **Monkey lung immunity: response to locally deposited antigen.** Mason, M.J.; Bice, D.E.; Muggenburg, B.A. Dec 1983. NTIS, PC A21/MF A01. File Number TI84012996.

In Inhalation Toxicology Research Institute annual report, October 1, 1982-September 30, 1983.

Two male cynomolgus monkeys were immunized and subsequently challenged by local deposition of antigen in a single lung lobe. The immune response was monitored for 10 to 12 days after each of three immunizations. The response in the lung lobe to immunization was characterized by increased numbers of IgM, IgG, and IgA antibody-forming cells (AFC), as well as increased levels of specific antibody of all three classes. The peak numbers of AFC were noted between 7 and 10 days after immunization. The peak immune response (AFC and specific immunoglobulin levels) was increased by each subsequent antigen exposure. The cellular response to the antigen was characterized by increased numbers of lymphocytes, macrophages, and neutrophils. The immune response in the cynomolgus monkey appears to be similar to what would be expected in the human lung. This model could be applied in toxicity testing to evaluate the effects of inhaled toxicants on the pulmonary immune response.

48586 (LMF—107, pp 343-347) **Immune responses in rabbits after localized lung immunization.** Bice, D.E.; Muggenburg, B.A. Dec 1983. NTIS, PC A21/MF A01. File Number TI84012996.

In Inhalation Toxicology Research Institute annual report, October 1, 1982-September 30, 1983.

The localized deposition of particulate antigen in the lung of rabbits induced a peak number of specific IgM antibody-forming cells in the lung-associated lymph nodes at 7 days after immunization. Lymphoid tissues that did not receive lymphatic drainage from the lung (spleen and popliteal lymph nodes) had background numbers of antibody-forming cells. A low number of antibody-forming cells was found in the blood. However, lung immunization did not increase the accumulation of immune cells in the immunized lung lobes of rabbits. This response was similar to that reported previously for rats and different from that for dogs, subhuman primates, and man.

48587 (LMF—107, pp 348-351) **Improved method for calculating labeling indices of lung epithelial cells.** Shami, S.G.; Caton, T.M.; Griffith, W.C.; Evans, M.J. Dec 1983. NTIS, PC A21/MF A01. File Number TI84012996.

In Inhalation Toxicology Research Institute annual report, October 1, 1982-September 30, 1983.

An improved method has been developed to calculate labeling indices (LIs) of epithelial and interstitial cells in the airways and alveolar region of the lungs of rats. This method is more accurate and requires less time than the traditional method, which involves counting all labeled and unlabeled cells. In the new method, all labeled cells are counted, but the total number of cells is estimated, based on a representative sample count of airway and alveolar cells in each animal. The LIs as calculated by the two methods correlated very well. Most of the error in the new method was due to sampling error; very little was attributed to estimating the total number of cells.

48588 (LMF—107, pp 352-356) **Respiration of rats in nose-only exposure tubes.** Mauderly, J.L. Dec 1983. NTIS, PC A21/MF A01. File Number TI84012996.

In Inhalation Toxicology Research Institute annual report, October 1, 1982-September 30, 1983.

Respiration and body surface temperature of 3-, 6-, 12-, and 24-month-old rats were measured during confinement in two different styles of nose-only exposure tubes. No difference in respiration was found between rats in older and newer style tubes. Average minute volumes after 60 min of confinement were 1.40, 0.81, 0.67 and 0.70 ml/min/g body weight for 3-, 6-, 12-, and 24-month-old rats, respectively. The higher minute volume of the youngest rats was ascribed to excitement and a higher metabolic rate.

48589 (LMF—107, pp 357-360) **Toxicological aspects of the long-term depletion of reduced glutathione in mice given L-buthionine-S,R-sulfoximine.** Sun, J.D.; Ragsdale, S.S.; Benson, J.M.; Henderson, R.F. Dec 1983. NTIS, PC A21/MF A01. File Number TI84012996.

In Inhalation Toxicology Research Institute annual report, October 1, 1982-September 30, 1983.

L-buthionine-S,R-sulfoximine (BSO) added to the drinking water of mice was found to deplete reduced glutathione (GSH) in lungs, pulmonary lavage fluid, liver, kidneys, and blood in both a dose- and time-dependent manner. It was also found that BSO treatments did not show any biochemical indications of pulmonary or hepatic toxicities, or affect levels of lung or liver cytochrome P-450. Thus, this method for depleting GSH may be useful in toxicological studies requiring animals with decreased in vivo levels of GSH.

48590 (PB—84-201615) **Evaluation of chemical and biological methods for the identification of mutagenic and cytotoxic hazardous waste samples.** Andon, B.; Jackson, M.; Houk, V.; Claxton, L. Jun 1984. 27p. (EPA—600/D-84-150). NTIS, PC A03/MF A01.

Prepared in cooperation with Environmental Health Research and Testing, Inc., Research Triangle Park, NC and North Carolina Univ. at Chapel Hill, Dept. of Environmental Sciences and Engineering.

To assist in the development of methods for identifying potentially hazardous wastes, the authors have conducted studies on the extraction of toxicants from several solid waste samples. The extracts were tested for toxicity in the Chinese Hamster Ovary (CHO) Cytotoxicity Test and for mutagenic potential in the Salmonella Histidine Reversion Assay. A new technique was also employed which measured the mutagenicity of neat waste samples by coupling Thin Layer Chromatography (TLC) with the Salmonella Histidine Reversion Assay. The wastes selected for study were coke plant waste, herbicide manufacturing acetone-water effluent, and oil refining waste. Three extraction solvents, ethanol (ETOH), dichloromethane (DCM), and dimethylsulfoxide (DMSO), were chosen based on their solubility and compatibility with bioassay procedures. Each sample was divided into three parts and extracted with each of the three solvents separately. All extracts were tested in the Salmonella assay at five dose levels with five Ames tester strains in the presence and in the absence of an exogenous metabolizing system. DMSO and DCM extracts were utilized for CHO cytotoxicity evaluations. The three neat waste samples and two extracts were assayed with the TLC technique. In addition to the biological assessments, the gross chemical parameters for each sample were determined. Results showed that coke plant waste and herbicide mfg. acetone-water were mutagenic to S. typhimurium with the standard plate test. With the TLC technique, the neat coke plant waste was mutagenic and oil refining waste was toxic. Oil refining waste was also toxic to CHO cells.

48591 **(PB—84-209808) Health hazard evaluation report No. HETA 82-324-1279, Chemical Leaman Tank Lines, Inc., Stockertown, Pennsylvania.** Lewis, F. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Mar 1983. 12p. NTIS, PC A02/MF A01.

To evaluate concern about eye and skin irritation and long-term exposure effects from coal tar pitch exposures, on October 5, 1982, with the cooperation of both Chemical Leaman and Cooper's Creek Chemical, NIOSH conducted personal air sampling for coal tar pitch volatiles at the Cooper's Creek Facility. Breathing-zone air samples for coal tar pitch volatiles were taken on two of Chemical Leaman's truck drivers; one for the loading operations, and the other for an unloading operation. Based on the environmental findings of this study, no health hazard existed during the loading and unloading operations of coal tar pitch at the Cooper's Creek Chemical site. However, recommendations are outlined to confirm good work practices to reduce personal contact with the substance(s) during valve and pipeline attachment and detachment.

48592 **(PB—84-210012) Health hazard evaluation report No. HETA 82-191-1267, Engineered Air Systems, Inc., St. Louis, Missouri.** Boiano, J.; Aw, T.C. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Feb 1983. 21p. NTIS, PC A02/MF A01.

On April 1-2, 1982, NIOSH evaluated workers acutely exposed to sulfur dioxide (SO2) following an industrial accident. On the morning of March 18, 1982, SO2 was released during chemical clean-up of a dip tank containing spent chromic acid solution. Sodium bisulfite, added to the tank as part of a disposal procedure, caused the evolution of SO2 and subsequent evacuation of 148 workers in the plant. Pulmonary function tests showed 1 out of 28 results reviewed was abnormal, a finding which may not be associated with SO2 exposure since results of similar tests done prior to the incident were unavailable for comparison. Other laboratory test results provided to NIOSH showed no recurrent pattern of abnormalities. Results of available medical tests did not show significant changes consistent with SO2 exposure among the affected workers. Recommendations to prevent similar incidents are presented.

48593 **(PB—84-210376) Health hazard evaluation report No. HETA 82-272-1276, Boeing Vertol Company, Philadelphia, Pennsylvania.** Chrostek, W.; Liss, G.M.; Moss, G. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Mar 1983. 27p. NTIS, PC A03/MF A01.

To evaluate employee health complaints, including anxiety, nausea, eye strain, and headache thought possibly related to working under high pressure sodium vapor (HPSV) lamps and working with storage boxes dipped in sulfur, air samples were collected in May and July 1982 for exposures to sulfates, sulfites, and sulfur dioxide. A calibrated photometer was used to measure illumination in units of lux. Self-administered questionnaires were completed. To further assess possible color distortion, investigators administered the Farnsworth-Munsell 100-Hue Test to 15 employees in Building

3-25. Environmental sampling found non-detectable levels of sulfite. The illumination levels in some parts of the building were far less than optimal. Although no serious adverse health effects were noted, symptoms related to the eyes and minor abnormalities of color discrimination, possibly related to HPSV lamps and exposure to sulfur containers, were detected. Recommendations to improve the lighting situation are presented.

48594 **(PB—84-210384) Health hazard evaluation report No. HETA 82-246-1275, Swissvale Auto Surplus Parts, Inc., Pittsburgh, Pennsylvania.** Aw, T.C.; Lee, S.A. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Mar 1983. 17p. NTIS, PC A02/MF A01.

To evaluate exposures to polychlorinated biphenyls (PCBs) (EPA had documented the presence of PCBs at the site in 1980), environmental samples by NIOSH on July 28, 1982, showed presence of PCBs for surface wipe samples at the scrap yard and wipe samples from scrap yard workers' hands. PCBs were also detected in the soil and surface dirt within the scrap yard. Five current workers were interviewed and none gave a history of liver disease, eye, or gastrointestinal disorders. Blood samples were taken from all five current workers for serum PCB levels showed Aroclor 1254 at a concentration of 14 ppb (detection limit 10 ppb) in the serum of one, and Aroclor 1260 at 11 ppb in another. The other three had no detectable Aroclor 1242, 1254, or 1260 in the serum. Six county health department workers provided blood samples for comparison of PCB levels. Recommendations include cleaning up the scrap yard, improving hygiene measures, and removing the contaminated soil.

48595 **(PB—84-210855) Health hazard evaluation report No. HETA 81-284-1292, Union Carbide Grafito, Yabucoa, Puerto Rico (revised).** Cone, J.E.; Lucas, A. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Feb 1984. 23p. NTIS, PC A02/MF A01.

To evaluate employee exposures to pitch, sulfur dioxide, and nuisance dust, personal breathing-zone samples were obtained in July and October 1981. Health questionnaires were completed on 97 exposed workers and on 36 less heavily exposed office and management workers. Physical examinations were performed on the sun-exposed areas of skin. Fourteen (44%) of 32 personal air samples (range 0.1 to 1.5 ppm, mean 0.4 ppm.) for sulfur dioxide exceeded NIOSH's recommendation of 0.5 ppm. All of the 18 workers wore respirators during at least part of their workshift so that their actual respiratory exposure may be less than that measured. Production workers reported experiencing phototoxic skin reactions when they were in the sun following exposure to pitch fume or dust. Physical examination findings revealed evidence of erythema or skin peeling (suggestive of phototoxic dermatitis) in 14 exposed workers and in 1 office control. A health hazard from exposure to sulfur dioxide existed in the graphitization area. In addition, PNAs were found in the air of the mill and mix, and pitch impregnation areas. Health and safety recommendations are included.

48596 **Nickel in plants. II. Distribution and chemical form in soybean plants.** Cataldo, D.A.; Garland, T.R.; Wildung, R.E. (Battelle Pacific Northwest Lab., Richland, WA). *Plant Physiology;* **62**: 566-570(1978).

The gross tissue distribution, intracellular fate, and chemical behavior of Ni^{2+} in soybean plants (Glycine max cv. Williams) were investigated. Following root absorption, Ni was highly mobile in the plant, with leaves being the major sink in the shoots for Ni during vegetative growth. A senescence $> 70\%$ of the Ni present in the shoot was remobilized to seeds. Fractionation of root and leaf tissues showed $> 90\%$ of the Ni to be associated with the soluble fraction of tissues; ultrafiltration of the solubles showed $> 77\%$ of the Ni to be associated with the 10,000 to 500 molecular weight components of both roots and leaves. Chemical characterization of the soluble components (10,000 to 500 and > 500 molecular weight) by thin layer chromatography and electrophoresis resolved a number of Ni-containing organic complexes. Major Ni-containing components formed in the root are transported in the xylem stream, and undergo partial modification on deposition in leaves. Nickel accumulated in seeds is primarily associated with the cotyledons. Chemical fractionation of cotyledon components showed 80% of the Ni to be associated with the soluble whey fraction, while 70% of this fraction was composed of Ni-containing components with molecular weight $< 10{,}000$.

48597 **Biochemical indicators of environmental pollution.** Goldstein, G. (Oak Ridge National Lab., TN). pp 109-131 of Indicators of environmental quality. Vol. 1. Thomas, W.A. (ed.). New York, NY, USA; Plenum Press (1972). (CONF-711203—).

From American Association for the Advancement of Science annual meeting; Philadelphia, PA, USA (26 Dec 1971).

A review is presented of studies related to the concept of biochemical indicators, particularly those which could appear to be likely candidates for monitoring of environmental pollutants. The use of plant tissues, animal tissues, blood, cell cultures and cell-free systems are discussed. Enzymatic methods are discussed in detail. Indicator enzymes are listed for detection of peroxyacetyl nitrate, ozone and SO_2; for beryllium, bismuth, iron, copper, manganese, cobalt, lead, silver and mercury.

58 GEOSCIENCES

5801 Geology And Hydrology

REFER ALSO TO CITATION(S) 58010047505, 47506, 47509, 47517, 47535, 47536, 47544, 47561, 48500

48598 **(USGS-OFR—84-491) Stratigraphic and structural relations of volcanic rocks in drill holes USW GU-3 and USW G-3, Yucca Mountain, Nye County, Nevada.** Scott, R.B.; Castellanos, M. (Geological Survey, Denver, CO (USA); Fenix and Scisson, Inc., Mercury, NV (USA)). 1984. Contract AI08-78ET44802. 136p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85001367.

Major silicic ash-flow tuffs extend through Yucca Mountain with only minor variations in thickness, but the tuffs vary somewhat in degree of welding, physical properties, and extent of alteration. Two major faults sets cut Yucca Mountain at the surface. One set consists of Basin and Range style normal faults. These faults strike north-northwest to north-northeast, and in oriented core from USW GU-3, have a dominant north-northwest strike. Although most movement on the faults occurred between 13 and 11.5 m.y. ago, minor activity has persisted into the Pleistocene. The other fault set consists of northwest-striking strike-slip faults that appear to have right-lateral offset with activity restricted to between 13 and 11.5 m.y. ago. In age, attitude, sense of offset, and geographic location these faults seem to be related to the Walker Lane-Las Vegas Valley shear zones. These faults are largely restricted to the northern part of Yucca Mountain and are not observed in core from drill holes USW GU-3 and USW G-3. Fractures in drill holes USW GU-3 and USW G-3 have a dominant north-northwest strike and a steep southwest dip parallel to fractures observed on the surface. In the upper kilometer of rock, fracture densities in densely welded tuff are between 20 and 40 fractures per unit cubic meter and between less than 1 and about 3 fractures per unit cubic meter in nonwelded tuff. Below depths of 1 kilometer, the density of fractures is roughly an order of magnitude lower, from 3.5 fractures per unit cubic meter in moderately welded tuff to 0.3 fractures per unit cubic meter in nonwelded tuff. Because fractures provide the major conduits for movement of both vadose and ground water in these tuffs, the correlation between density of fractures and degree of welding of these tuffs becomes important for characterization of this potential nuclear waste repository. 39 references, 31 figures, 13 tables.

48599 **(USGS/WRIR—83-4218) Regional hydrology of the Blanding-Durango area, southern Paradox Basin, Utah and Colorado.** Whitfield, M.S. Jr.; Thordarson, W.; Oatfield, W.J.; Zimmerman, E.A.; Rueger, B.F. (Geological Survey, Lakewood, CO (USA)). 1983. Contract AI97-79ET44611. 124p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE84017236.

Principal findings of this study that are pertinent to an assessment of suitability of the hydrogeologic systems to store and contain radioactive waste in salt anticlines of adjacent areas are:

water in the upper ground-water flow system discharges to the San Juan River - a major tributary of the Colorado River. Discharge of water from the upper aquifer system to streambed channels of the San Juan River and its tributaries during low-flow periods primarily is through evapotranspiration from areas on flood plains and maintenance of streamflow; the lower ground-water system does not have known recharge or discharge areas within the study area; subsurface inflow to this system comes from recharge areas located north and northeast of the study area; the upper and lower ground-water systems are separated regionally by thick salt deposits in the Blanding-Durango study area of the Paradox basin; potential exists in mountainous areas for downward leakage between the upper and lower ground-water systems, where salt deposits are thin, absent, or faulted; no brines were found in this study area with outflow to the biosphere; water in the upper ground-water system generally is fresh. Water in the lower ground-water system generally is brackish or saline; and ground-water flow disruptions by contiguous faults probably are common in the upper ground-water system. These disruptions of flow are not apparent in the lower ground-water system, perhaps because available hydrologic data for the lower ground-water system are scarce. The above major findings do not preclude the potential for waste storage in salt; however, they do not allow the prediction of detailed ground-water flow rates and directions through this area. 55 references, 13 figures, 15 tables.

48600 **Thermoluminescence of the mineral components in granite.** Schwartzman, R.G. (Department of Materials Science and Engineering, State University of New York at Stony Broke, Long Island, New York, U.S.A.); Kierstead, J.A.; Levy, P.W. (Brookhaven National Laboratory, Upton, New York, U.S.A.). pp 163-174 of 3. specialist seminar on TL and ESR dating. Hackens, T.; Mejdahl, V.; Bowman, S.G.E.; Wintle, A.G.; Aitken, M.J. (eds.). Roskilde, Denmark; Risoe National Laboratory (1983). (CONF-820764—). Contract AC02-76CH00016.

From 3. international seminar on thermoluminescence and ESR dating; Elsinore, Denmark (26 Jul 1982).

The thermoluminescence (TL) of the minerals in Climax Stock (Nevada, USA) granite has been studied. The principal mineral constituents are plagioclase, quartz, potassium fledspar and biotite. Pyrite, sphene, apatite and zirconium occur at one percent or less. All exhibit TL except biotite. The TL kinetics were determined for plabgioclase, quartz, potassium feldspar and pyrite. Plagioclase and potassium feldspar exhibit second order and pyrite first order kinetics. Natural TL of quartz follows second order and artificial TL first order kinetics. However, unrealistic kinetic parameters are often obtained for these four minerals; thus more general kinetics, e.g. interactive kinetics, may apply.

5802 Geophysics

48601 **(AD-A—139675/3) Deterministic methods of seismic source identification. Annual technical report 1 October 1982-30 September 1983.** Archambeau, C.B. (Cooperative Inst. for Research in Environmental Science, Boulder, CO (USA)). 30 Sep 1983. 111p. NTIS, PC A06/MF A01.

In this report, we describe specific research results in: (1) The theoretical basis for seismic event discrimination and for the inference of physical parameters describing seismic sources; (2) Observations of body wave magnitude residuals in the U.S. and Southern Canada and the implications for yield estimation at non-U.S. and/or U.S. test sites; (3) Inferences of magnitude-yield relationships for both U.S. and U.S.S.R. test areas, with applications of these relations to U.S. and Russian nuclear test observations, to obtain new yield estimates; (4) Studies of a variety of physical situations which would produce seismic observations for an earthquake making it appear anomalous (i.e., explosion-like) when viewed from the perspective of standard discrimination methods, and similarly physical situations were described for which explosions could appear earthquake-like, and which could also lead to large yield estimate errors.

48602 **(CONF-8409115—1) Field implementation of geophysical diffraction tomography.** Witten, A.J.; Stevens, S.S. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84017594.

From 6. annual Low-Level Waste Management Program participants information meeting; Denver, CO, USA (11 Sep 1984).

Geophysical diffraction tomography is a new technique that shows promise as a tool for quantitative subsurface (below-ground) imaging. The approach being used is based upon the filtered backpropagation algorithm, which is a mathematical extension of the reconstruction software used in conventional X-ray CAT scanners. The difference between this method and existing methods is that the new algorithm rigorously accounts for diffraction effects through an exact inversion of the wave equation. This refinement is necessary in that it admits the use of acoustic and long-wavelength electromagnetic waves, allowing tomography to be taken from the laboratory to the field. ORNL's effort in geophysical diffraction tomography involves reducing the filtered backpropagation algorithm to practice. This requires the design and construction of field instrumentation as well as the development of an improved algorithm. The original algorithm requires the imaged region to be illuminated by plane waves. This requirement simplifies the algorithm but complicates its field implementation in that plane waves are difficult to generate. Consequently, ORNL has been working to generalize the filtered backpropagation algorithm to allow a broader range of incoming wave fields which can more easily be realized in the field. The instrumentation aspects involve the selection of appropriate sonic sources and receivers along with the development of a state-of-art, portable, computer-controlled, multichannel data acquisition system. 5 references, 6 figures.

48603 **(UCRL—91422) Acoustic tomographic reconstruction of anomalies in three-dimensional bodies.** Bevensee, R.M. (Lawrence Livermore National Lab., CA (USA)). Aug 1984. Contract W-7405-ENG-48. 8p. (CONF-840738—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE84017035.

From Progress in quantitative NDE; San Diego, CA, USA (8 Jul 1984).

We present a theory of acoustic tomography based on data processing shear wave scattered field over an observational plane, including frequency and polarization diversities. The theory is based on the Gubernatis formulation of scattering and does not require solution of the Fredholm equation for material displacement u. An essential feature of the theory is an expansion of v/sub jk/u/sub k/ in even powers of frequency to obtain an equivalent frequency insensitive source in the anomaly. We treat data inversion both in cartesian coordinates via the two-dimensional fast-Fourier transform (FFT) and in cylindrical coordinates via the one-dimensional Hankel transform. We note the advantages of polarization diversity. Sampling formulae are quoted. AR (auto regressive) and ARMA (auto regressive moving-average) modeling are mentioned as means of improving anomaly resolution. Both frequency and polarization diversities tend to reduce speckle noise. 5 references.

5803 Mineralogy, Petrology, And Rock Mechanics

REFER ALSO TO CITATION(S) 58030047494, 47532

48604 **(BMI/OCRD—4(4)) Hard rock excavation at the CSM/OCRD test site using crater theory and current United States controlled smooth wall blasting practices, June 1982.** Sperry, P.E.; Chitombo, G.P.; Hustrulid, W.A. (Colorado School of Mines, Golden (USA)). Aug 1984. Contract AC06-76RL01830;AC02-83CH10140;AC02-83CH10139. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85001802.

This report is the fourth in a series describing experiments conducted by the Colorado School of Mines for the Office of Crystalline Repository Development (OCRD) to determine the extent of blast damage in rock surrounding an underground opening. The report describes the application of tunnel design procedures based upon crater theory and current United States controlled smooth wall blasting practices for the excavation of the CSM/OCRD test room in the Colorado School of Mines, Experimental Mine (Edgar Mine) in Idaho Springs, Colorado. Ten blast rounds were used to excavate the test room. The first seven rounds were designed with Swedish Techniques, and described in the third report in this series, and the design of rounds eight through ten used crater theory. Crater theory is described in this document along with its application to the CSM/OCRD Room excavation. Calculation for spacing, burden, number and type of holes, explosives placement, and overall powder factor are discussed. A series of single charge cratering test shots, designed to evaluate some of the input data for the blast designs, are discussed. The input data include: Strain Energy Factor E, a dimensionless factor which varies according to the explosive and rock type; Critical Depth, N, the charge depth at which the explosive begins to fracture rock at the free face; Optimum Depth Ratio Δ_0, which is a ratio between Optimum Charge Depth, d_0, and Critical Charge Depth, d/sub c/; and charge Weight, W. A non-linear least squared regression method to best fit the general bell-shape curve of the crater results is discussed. Both scaled weight and scaled volume criteria are reported in the analysis of results. 10 references, 17 figures, 16 tables.

48605 **(NP—5900084) Initial core descriptions, Deep Sea Drilling Project: Leg 88 - downhole marine seismic experiments in the Northwest Pacific Basin; Leg 91 - Ngendei expedition, downhole marine seismic experiments in the Tonga Basin.** Lancelot, Y. (Scripps Institution of Oceanography, La Jolla, CA (USA)). 14 Feb 1984. 109p. NTIS, PC A06/MF A01. File Number DE85900084.

This report consists of site data and sedimentologic and paleontologic data and interpretations as known six months post-cruise. The purpose is for sample selection by interested earth scientists. (ACR)

48606 **Thermal conductivity of partially saturated materials.** Hadley, G.R. (Sandia National Laboratories, Albuquerque, NM). *American Society of Mechanical Engineers, [Paper]*; **83-HT-89**: 6(Jul 1983).

This paper reports the measurement of thermal conductivity of two samples of volcanic rock as a function of water saturation over the entire saturation range (0,1). Gamma beam densitometry was used to monitor saturation as the samples dried. This technique is accurate and nonintrusive, and should be applicable for granular materials also.

5804 Geochemistry

REFER ALSO TO CITATION(S) 58040048258, 48514, 48600

48607 (INIS-mf—9065, pp 16-18) **Analysis of neutron moisture meter measurements using multigroup diffusion code techniques.** Wilson, D.J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nov 1983. NTIS (US Sales Only), PC A10/MF A01. File Number TI84780622. (CONF-8311183—).

From 3. Australian conference on nuclear techniques of analysis; Lucas Heights, Australia (1 Nov 1983).

The thermal neutron flux at the detector of a neutron moisture gauge is calculated using a multigroup diffusion code. The relationship between the soil water density and the thermal neutron flux is determined, together with the perturbations introduced by variations in the soil density and its neutron absorption and scattering qualities. Errors due to the different parameters and the relationship between count rate and thermal neutron flux are discussed.

5805 Oceanography

48608 **(DOE/EV/10005—84/14) Analysis of flow within the coastal boundary layer off Long Island, New York.** Churchill, J.H. (Woods Hole Oceanographic Institution, MA (USA)). Apr 1984. Contract AC02-79EV10005. 75p. (WHOI—84-14). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85001384.

From 1974 through 1978 a series of intensive measurements were made in the coastal waters within 12 km of Long Island. The data were derived from two sources: a mooring array from which time series of temperature, salinity and water velocity were measured at four depths at each of four offshore distances; and high resolution, daily hydrographic surveys. Analysis of subtidal cross-shore velocity fluctuations has indicated a two-layer response to wind forcing, with near-surface flow to the right of the longshore wind and opposing flow below. The magnitude of these fluctuations increased in the seaward direction on a scale nearly equal to the internal deformation radius. The phase between longshore velocity fluctuations and longshore wind stress approached zero with decreasing bottom depth, probably the result of bottom stress. The vertical structure of longshore fluctuations during stratified conditions markedly differed from that during unstratified conditions, and resembled the structure derived from a simple two-layer coastal flow model. Significant mean offshore flow was measured during experiments in August and September, despite negligible mean wind stress during the same periods. This flow was most likely due to persistent longshore density gradients, as are consistently inferred from hydrographic data taken in the vicinity. 36 references, 25 figures.

48609 **(DOE/EV/10005—84/15) Slope water intrusions within the nearshore waters off Long Island, New York.** Churchill, J.H. (Woods Hole Oceanographic Institution, MA (USA)). Apr 1984. Contract AC02-79EV10005. 65p. (WHOI—84-15). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85001386.

From 1974 through 1978 intensive measurements were made of the salinity, temperature and current structure of the waters within 12 km of the Southern Long Island coastline. The data were derived from two sources: a mooring array from which time series of temperature, salinity and water velocity were measured at four depths at each of four offshore distances; and high resolution, daily STD and current meter surveys. During August and September intrusions of slope or outer shelf water were often observed by the STD surveys. Three intrusions have been studied in detail. Two were observed at mid-depth following periods of upwelling favorable winds. Concurrent hydrographic and current meter data suggest that these water masses were transported shoreward by a combination of wind forcing and longshore density gradients. The third intrusion, initially observed near the surface, had coinciding salinity and temperature maxima. This water mass appears to have entered the shelf as a result of a shelf/slope water exchange, possibly induced by a warm-core ring near the shelf break. Such intrusions may commonly occur during the summer and fall and may be related to the appearance of tropical fish in the Long Island vicinity during these seasons. 22 references, 35 figures.

64 PHYSICS. I.

6401 Astrophysics And Cosmology

48610 **(DOE/ER/40008—60) Cosmic axions.** Sikivie, P. (Florida Univ., Gainesville (USA). Dept. of Physics). 1984. Contract AS05-81ER40008. 15p. (CONF-8404155—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE85001330.

From 5. workshop on grand unification; Providence, RI, USA (12 Apr 1984).

Theoretical Physics Preprint Series UFTP-84-5.

Axion physics is briefly reviewed, including the constraints on the axion decay constant from laboratory experiments, from stellar evolution and from the cosmological axion energy density. Experiments to detect axions emitted by the sun or axions floating about in the halo of our galaxy are discussed. 19 references.

48611 **(DOE/ER/40008—62) Supersymmetric inflationary cosmology.** Ramond, P. (Florida Univ., Gainesville (USA). Dept. of Physics). 1984. Contract AS05-81ER40008. 17p. (CONF-8406172—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE85001332.

From 8. Johns Hopkins conference on particle physics; Baltimore, MD, USA (20 Jun 1984).

Theoretical Physics Preprint Series UFTP-84-7.

We view the general requirement imposed on cosmology by particle physics. In particular, we discuss a model which includes inflation, supersymmetry and Grand Unification. We show how this model can be used to put an upper bound on the proton life-time.

48612 **(FRNC-TH—1535) Study of X-ray and gamma ray sources observed by the SIGNE (Prognoz 6 Satellite) experiment in the regions of the galactic center and anticenter.** Violes, F. (Toulouse-3 Univ., 31 (France)). Dec 1981. 116p. (In French). NTIS (US Sales Only), PC A06/MF A01. File Number DE84751749.

Characteristics of the SIGNE II MP 6 experiment are reported and procedures to obtain the fluxes detected from all the sources are described. We next present the deconvolution method used to isolate the galactic center sources. In the last chapter we present and discuss the photon spectra of the sources observed by the SIGNE II MP 6 experiment.

48613 **(INIS-mf—8783) Observations of fast, transient gamma-ray phenomena.** Kouveliotou, C. (Technische Univ. Muenchen, Garching (Germany, F.R.). Fakultaet fuer Physik). 28 Jul 1981. 205p. NTIS (US Sales Only), PC A10/MF A01. File Number DE84780561.

The present work is devoted primarily to the study of the solar GRBs as seen by the ISEE-3 satellite, in the energy range between 100 keV and 6.5 MeV. We have also included the cosmic GRB observations from ISEE-3, as a direct comparison for the two phenomena. Thus this thesis comprises 7 chapters: introduction, a chapter providing information on the instruments used, a discussion on the physics of the gamma-ray emission, a chapter describing the cosmic GRBs, and a chapter analysing the solar ones. Finally, we give the conclusions and a summary of our results and indications for the future observations.

48614 **(PB—84-201516) Solar-geophysical data number 475, March 1984. Part 2 (comprehensive reports). Data for September 1983, May 1981 and miscellanea.** (National Geophysical Data Center, Boulder, CO (USA)). Mar 1984. 128p. (SGD—475-PT-2). NTIS, PC A07/MF A01.

See also PB84-188671 and PB84-201508. Library of Congress catalog card No. 79-640375.

Contents: Detailed Index for 1983/1984; Data for September 1983--(Solar radio bursts at fixed frequencies, Mass ejections from the sun); Data for May 1981--(Solar flares May 1981); Miscellaneous data--(Active regions Meudon 8 May - 29 July 1983, Synoptic Solar maps 8 May - 29 July 1983, Interplanetary solar particles and plasma IMP 8 data for 1981, ERRATA- GOES 2 satellite X-ray plots for 6 - 10 July 1982).

48615 **Inflationary cosmology and the mass hierarchy in locally supersymmetric theories.** Ovrut, B.A.; Steinhardt, P.J. (Department of Physics, The Rockefeller University, New York, New York 10021). *Physical Review Letters;* **53**: No. 7, 732-735(13 Aug 1984). Contract AC02-81ER40033;AC02-76ER03071.

We present an $N = 1$ locally supersymmetric theory in which all constraints for a successful new inflationary-universe scenario are satisfied and the gravitino mass is on the order of the electroweak scale. Sufficient baryon asymmetry is generated and the overproduction of entropy due to gravitinos and/or coherent field oscillations (which is typical of supersymmetric models) is avoided.

48616 **Reexamination of rotational and tangential discontinuities in the solar wind.** Neugebauer, M.; Clay, D.R.; Goldstein, B.E.; Tsurutani, B.T.; Zwickl, R.D. (Jet Propulsion Laboratory, California Institute of Technology). *Journal of Geophysical Research;* **89**: No. A7, 5395-5408(1 Jul 1984).

ISEE 3 magnetic field and proton data are used to study the properties of rotational and tangential discontinuities in the solar wind. A Sonnerup-Cahill minimum variance analysis of the magnetic field data is used to determine the direction of the normal to each discontinuity. The discontinuities are then classified as rotational (RD), tangential (TD), or either (ED), depending on the relative values of the normal field component and the change of field magnitude across them. This process yields substantially more RD's than TD's, in agreement with earlier studies using this method of classification. Other field and plasma parameters are then examined for each of these three groups. The field magnitude passes through a local minimum while the field direction is changing for some TD's but not for RD's. The first and second adiabatic invariants for protons and the helium abundance are approximately conserved across RD's but not across TD's, although the helium abundance is observed to change at a small fraction of the RD's. The product of plasma density times the anisotropy factor tends to be conserved across all three types. The relative directions of the velocity and field changes across all three types of discontinuity are consistent with the propagation of RD's outward from the sun, even though no such relation is predicted for TD's. The magnitude of the velocity change at RD's is smaller than that predicted by MHD theory, and the use of a two-stream fit to the proton data reduces, but does not remove, this discrepancy. The speeds of the alpha particles and the secondary proton beam relative to the primary proton beam result in little interaction between the alphas and RD's, while the primary and secondary proton beams flow through RD's in opposite directions and have oppositely directed velocity changes. The plasma conditions at ED's show a closer resemblance to RD's than to TD's.

48617 **Suprathermal ions upstream from interplanetary shocks.** Gosling, J.T.; Bame, S.J.; Feldman, W.C.; Paschmann, G.; Sckopke, N.; Russell, C.T. (University of California, Los Alamos National Laboratory). *Journal of Geophysical Research;* **89**: No. A7, 5409-5418(1 Jul 1984).

Suprathermal ions with energies between solar wind thermal energies and ~29 keV are occasionally observed ahead of outward propagating interplanetary shocks with the Los Alamos/Garching fast plasma experiment on ISEE 1 and 2. Compared with suprathermal ion velocity distributions observed upstream from the earth's bow shock, the upstream interplanetary shock ion velocity distributions are relatively structureless, and the particle fluxes are less intense. Typically the suprathermal ion distribution emerges smoothly from the solar wind thermal distribution and is nearly isotropic in the solar wind frame. Such distributions are observed with the fast plasma experiment only in association with interplanetary shocks. Field-aligned beams, kidney-bean-shaped distributions, shells of ions in velocity space, and bunches of gyrating ions-all common to the upstream region of the earth's bow shock-have not been observed ahead of interplanetary shocks. Highly structured ion velocity distributions observed upstream of the earth's bow shock apparently are caused directly or indirectly by the nearly specular reflection of solar wind ions at the shock, a consequence of the generally high Mach number of the solar wind flow at 1 AU. By way of contrast, most interplanetary shocks at 1 AU have low, subcritical Mach numbers, and solar wind ion reflection at these shocks does not appear to play a role in producing upstream suprathermal ion distributions at 1 AU. Nevertheless, solar wind ions are accelerated to high energies at interplanetary shocks. Leakage of shocked thermal plasma across these low-Mach-number shocks from the downstream region may play an important role in producing upstream suprathermal ion populations and may therefore constitute the first step in the acceleration of solar wind ions to high energies at these shocks.

48618 **Plasma and energetic particle structure upstream of a quasi-parallel interplanetary shock.** Kennel, C.F.; Scarf, F.L.; Coroniti, F.V.; Russell, C.T.; Wenzel, K.; Sanderson, T.R.; Van Nes, P.; Feldman, W.C.; Parks, G.K.; Smith, E.J.; Tsurutani, B.T.; Mozer, F.S.; Temerin, M.; Anderson, R.R.; Scudder, J.D.; Scholer, M. (Space Sciences Department, TRW Space and Technology Group). *Journal of Geophysical Research;* **89**: No. A7, 5419-5435(1 Jul 1984).

This paper assembles ISEE 1, 2, and 3 observations of the interplanetary magnetic and electric fields, plasma, magnetohydrodynamic waves, electromagnetic and electrostatic plasma waves, 1- to 6-keV protons and electrons, and >30-keV/Q ions for the interplanetary shock of November 12, 1978. The shock was high speed (640 km s^{-1}), supercritical, quasi-parallel, and an efficient accelerator of energetic protons. The flux of >35-keV protons increased by a factor of 15 in the last 45 min and 270 R/sub E/ before shock encounter. The >10-keV proton energy density approached that of the magnetic field and thermal plasma upstream of the shock. The shock was inside a closed magnetic structure that was connected at both ends to the shock. The intensity of ion acoustic and low-frequency MHD waves increased inside the closed magnetic bubble.

48619 **Structure of the November 12, 1978, Quasi-Parallel interplanetary shock.** Kennel, C.F.; Edmiston, J.P.; Scarf, F.L.; Coroniti, F.V.; Russell, C.T.; Smith, E.J.; Tsurutani, B.T.; Scudder, J.D.; Feldman, W.C.; Anderson, R.R.; Mozer, F.S.; Temerin, M. (Department of Physics, University of California, Los Angeles). *Journal of Geophysical Research;* **89**: No. A7, 5436-5452(1 Jul 1984).

An objective of this paper is to determine the jump in plasma parameters across the November 12, 1978, interplanetary shock, sufficiently accurately to test in a subsequent paper a major prediction of shock acceleration theory: the dependence of the energetic ion spectral index upon the density compression ratio. We use ISEE 1 and 3 measurements of the magnetic field and electron and proton densities, temperatures, and bulk velocities, as well as ISEE 3 alpha particle measurements, and confirm the ISEE 1 electron densities using plasma wave measurements. We solve for the shock normal using four independent methods and show that the upstream and downstream flow parameters are consistent to better than 10% with $\gamma = 5/3$ Rankine-Hugoniot jump conditions. We conclude that the November 12, 1978, shock was a high-speed (612 km s^{-1}), supercritical, quasi-parallel (θ/sub B//sub n/ = 41°) shock of moderate strength (fast Mach number of 2.8) propagating into an upstream plasma whose total β was 1.14 and whose electron-to-proton temperature ratio was 2.8. This shock had three dissipative scale lengths, one of a few Larmor radii associated with its magnetic field jump, one of about 10 R/sub E/ associated with electron equilibration, and one of about 30 R/sub E/ associated with an energetic proton foreshock.

48620 **Microcanonical quantum gravity.** Strominger, A. (Inst. for Advanced Study, Princeton, NJ). *General Relativity and Gravitation;* **15**: 489-493(May 1983). Contract AC02-76ER02220.

A statistical mechanics approach to quantum gravity can be used to investigate the characteristics of the uncontrollable divergences in calculations of quantum gravity fields. The relation between quantum field theory and statistical mechanics is examined and it is found that the Euclidean functional integral describes the statistical mechanics of classical fields in 4 + 1 dimensions. The Hawking equation (1979) can therefore be used to calculate correlation functions on a four-dimensional Euclidean manifold. The infinite energy density UV catastrophe, i.e., the action density, is shown not to be renormalizable in a quantum gravity field. Several examples of the divergence are discussed, including ensemble averaging of black hole energies, and the quantum corrections to gravitational processes at nonrelativistic energies, wherein divergence occurs when the Planck energy is reached. Microcanonical quantum field theory, however, generates microcanonical correlation functions that are finite and well-behaved, and describe a wider class of self-consistent systems through a fixed action formalism.

48621 **Monopole heat.** Turner, M.S. (Chicago Univ., IL). *Nature (London);* **302**: 804-806(28 Apr 1983). Contract AC02-80ER10773.

A bound on the local flux of magnetic monopoles moving more slowly than 3 x 10 to the -5th c is derived by requiring the energy released to be less than the measured heat flow at the surface of the earth. Similar arguments are used to derive a bound on the flux of monopoles at Jupiter moving more slowly than 0.001 c. Energy loss due to eddy currents induced by the monopoles motion through the earth and Jupiter are taken into account, as well as energy loss via hadronic interactions and catalysis reactions. The energy released by nucleon decay catalyzed by captured monopoles is calculated. The integrated heat flow at the surface of the earth is then used to set a bound on the nucleon decay and on the flux of monopoles.

48622 **Evolution of interacting, magnetized, galactic plasmas.** Peratt, A.L.; Green, J.C. (Los Alamos National Lab., Los Alamos, NM). *Astrophysics and Space Science;* **91**: 19-33(Mar 1983).

The advent of three-dimensional, electromagnetic, and fully relativistic particle simulations allows a detailed study of a magnetized, rotating plasma, galaxy model. When two such models are simulated, an interaction yielding results resembling observational data from double radio sources, including the emission of synchrotron radiation, are obtained. Simulation-derived morphologies, radiation intensities, frequency spectra, and isophote patterns are directly compared to observations. The constituent plasma parameters associated with the source Cygnus A are found to be n(e) 0.0018/cu cm, T 2.8 keV, B 20-30 gamma, with a small population of electrons accelerated to GeV energies by a rotation induced electric field. The results of these simulations, involving a computational resource of five CDC 7600 and five Cray-1 computers, strongly supports an inhomogeneous version of the Klein world model.

48623 **Neutral hydrogen observations of the dwarf elliptical galaxies NGC 185 and NGC 205.** Gottesman, S.T. (Florida Univ., Gainesville (USA). Dept. of Physics and Astronomy); Johnson, D.W. (Battelle Pacific Northwest Labs., Richland, WA (USA). Battelle Observatory). pp 307-308 of Internal kinematics and dynamics of galaxies. Proceedings of the IAU symposium no. 100 held in Besancon, France, August 9-13, 1982. Athanassoula, E. (ed.) (Observatoire de Besancon (France)). Dordrecht, Netherlands; D. Reidel (1983). (CONF-8208198—).

From International Astronomical Union symposium on internal kinematics and dynamics of galaxies; Besancon, France (9 Aug 1982).

In this note the authors report the detection and mapping of neutral hydrogen in two dwarf elliptical galaxies NGC 185 and NGC 205. Both are companions to M 31 and both are classified as peculiar owing to the presence of obscurring dust patches near their nuclei. Both galaxies also contain a small population of blue, presumably young stars. It is found that in each system the centroid of the gas is significantly offset from the center of the galaxy. 2 figs., 5 refs.

6402 Atmospheric Physics

48624 **(N—84-23039) Ongoing data reduction, theoretical studies and supporting research in magnetospheric physics.** Scarf, F.L.; Greenstadt, E.W. (TRW Systems and Energy, Redondo Beach, CA (USA)). Apr 1984. 10p. (NASA-CR—173419). NTIS, PC A02/MF A01.

Data from ISEE-3, Pioneer Venus Orbiter, and Voyager 1 and 2 were analyzed. The predictability of local shock macrostructure at ISEE-1, at the Earth's bow shock, from solar wind measurements made up-stream by ISEE-3, was conducted using computer graphic format. Morphology of quasi-parallel shock was reviewed. The review attempted to interrelate various measurements and computations involving the q-parallel structure and foreshock elements connected to it. A new classification for q-parallel morphology was suggested.

48625 **(N—84-23041) Energetics of the magnetosphere, revised.** Stern, D.P. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Feb 1984. 42p. (NASA-TM—86063). NTIS, PC A03/MF A01.

The approximate magnitudes of power inputs and energies associated with the Earth's magnetosphere were derived. The nearest 40 R sub E of the plasma sheet current receive some 3.10 to the 11th power watt, and much of this goes to the Birkeland currents, which require 1-3 10 to the 11th power watt. Of that energy, about 30% appears as the energy of auroral particles and most of the rest as ionosphere joule heating. The ring current contains about 10 to the 15th power joule at quiet times, several times as much during magnetic storms, and the magnetic energy stored in the tail lobes is comparable. Substorm energy releases may range at 1.5 to 30 10 to the 11th power watt. Compared to these, the local energy release rate by magnetic merging in the magnetosphere is small. Merging is essential for the existence of open field lines, which make such inputs possible. Merging also seems to be implicated in substorms: most of the released energy only becomes evident far from the merging region, though some particles may gain appreciable energy in that region itself, if the plasma sheet is squeezed out completely and the high latitude lobes interact directly.

48626 **(N—84-23053) Quick-look tables of continuous pulsations (Pc1) and Intervals of Pulsations of Diminishing Periods (IPDP) magnetic pulsation events recorded in Finland during IMS years 1976-1979: data summary.** (Oulu Univ. (Finland)). Apr 1982. 80p. NTIS, PC A05/MF A01.

Short period magnetic pulsations recorded at five stations during the IMS are summarized. The occurrence of continuous and diminishing period events is indicated. Each data sheet includes 10 days of observations. (ESA)

48627 **(N—84-23054) User's manual of a program to compute the distribution of photoelectrons.** Duboin, M.L.; Lejeune, G. Feb 1982. 48p. (In French). (CRPE-NT—110). NTIS, PC A03/MF A01.

A program to compute the evolution of a flow of electrons in the atmosphere is described. The balance of the energy dissipated during elastic or inelastic scattering is also treated. The program computes production of electrons by solar irradiation, cross sections for all altitudes and energy levels, and the evolution of the flow through the atmosphere. (ESA)

48628 **(PB—84-205582) Space plasma physics at the Rutherford Appleton Laboratory.** Bryant, D.A.; Bingham, R.; Edwards, T.; Hall, D.S.; Ward, A.K. (Rutherford Appleton Lab., Chilton (UK)). 1984. 37p. (RAL—84-023). NTIS, PC E04/MF E04.

The Rutherford Appleton Laboratory (RAL) is contributing instruments and a spacecraft to several imminent and excitingly new explorations of the plasma phenomena arising from the interaction between the solar wind and the Earth, and the solar wind and a comet. The projects in which the Laboratory is engaged, in collaboration with university and other research groups in the UK and abroad, include the AMPTE mission, which will trace the flow of particles injected into the solar wind, the GIOTTO encounter with comet Halley, the VIKING exploration of the generation of the aurora, and the CRRES and ISTP missions to clarify the structure and dynamics of the Earth's magnetosphere. These projects are outlined, together with the results of recent studies of particle acceleration and pulsations in the aurora. (Copyright (c) Science and Engineering Research Council 1984.)

48629 **Associations of geomagnetic activity with plasma sheet thinning and expansion: A statistical study.** Hones,Jr., E.W.; Pytte, T.; West,Jr., H.I. (Los Alamos National Laboratory, University of California). *Journal of Geophysical Research;* **89**: No. A7, 5471-5478(1 Jul 1984).

Associations of geomagnetic activity in the auroral zone with thinnings and expansions of the magnetotail plasma sheet are examined statistically in this paper. We first identified many plasma sheet thinnings and expansions in plasma and particle data from VELA satellites and from OGO 5 without reference to the ground magnetic data. These events were grouped according to the location of the detecting satellite in the magnetotail. For each such group the times of thinning or expansion were then used as fiducial times in a superposed-epoch analysis of the geomagnetic AL index values that were recorded in 8-hour intervals centered on the event times. The results show that many plasma sheet thinnings and expansions are related to discrete negative bay structures that are the classical signature of substorms. Furthermore, they support earlier findings that plasma sheet thinning and expansion at the VELA orbit (rroughly-equal18 R/sub E/) tend to be associated with the onset of the auroral zone negative bay and the beginning of its subsidence, respectively. Earthward of rroughly-equal13-15 R/sub E/, plasma sheet expansion occurs near the time of the onset of the negative bay, again in agreement with earlier findings. A large fraction of plasma sheet expansions to half thicknesses of > or ≈6 R/sub E/ at the VELA orbit are associated not with a baylike geomagnetic disturbance but with subsidence of a prolonged interval of disturbance. The study also shows that many plasma sheet expansions are related simply to generally enhanced geomagnetic activity showing no baylike or other distinctive features.

48630 **Neutrino masses, mixing, and oscillations in the S_4 model of permutation symmetry.** Brown, T.; Pakvasa, S.; Sugawara, H.; Yamanaka, Y. (Department of Physics and Astronomy, University of Hawaii at Manoa, Honolulu, Hawaii 96822). *Physical Review [Section] D: Particles and Fields;* **30**: No. 1, 255-257(1 Jul 1984). Contract AM03-76SF00235.

In the S_4 model, we work out the simplest possible scheme for neutrino masses. We find that ν/sub e/ and ν/sub μ/ have dominant massless components but not ν/sub tau/. The mixing matrix is completely determined and ν/sub e/-ν/sub tau/ and ν/sub μ/-ν/sub tau/ oscillations are possible with known mixing angles and only one δm^2.

48631 **Simulation study of the loss cone driven cyclotron maser applied to auroral kilometric radiation.** Wagner, J.S.; Lee, L.C.; Wu, C.S.; Tajima, T. (Sandia National Lab., Albuquerque, NM). *Radio Science;* **19**: 509-518(Mar 1984). Contract AT06-76ER70005;FG05-80ET53088.

The linear growth and nonlinear saturation of electromagnetic radiation amplified by a hot (5-20 keV) population of electrons possessing a loss cone velocity distribution in the presence of a cold (20-500 eV) electron population are studied. A relativistic electromagnetic simulation code is used to study the emission process. Three cases are presented in detail to illustrate the generation process of auroral kilometric radiation. The first case, which has an electron plasma frequency omega(pe) 0.2 omega(ce) (electron cyclotron frequency) and possesses a double loss cone distribution, exhibits a strong narrow peak of the fast extraordinary mode (X mode) radiation just above the X mode cutoff frequency. The second case with omega(pe) 0.2 omega(ce) and a single loss cone distribution shows a preferred direction of propagation for the amplified radiation. The third case with omega(pe) 0.5 omega(ce) shows a peak in the ordinary mode (O mode) radiation. In all cases, the radiation saturates by turbulent scattering of resonant particles into the loss cone. 22 references.

6403 Atomic, Molecular, And Chemical Physics

REFER ALSO TO CITATION(S) 64030048190, 48191, 48193, 48215, 48243, 48799

48632 **(BNL—35100) Photoemission EXAFS on outer core levels.** Choudhary, K.M.; Rothberg, G.M.; denBoer, M.L.; Williams, G.P.; Hecht, M.H.; Lindau, I. (Stevens Inst. of Tech., Hoboken, NJ (USA); Polytechnic Inst. of New York, Brooklyn (USA); Brookhaven National Lab., Upton, NY (USA); Jet Propulsion Lab., Pasadena, CA (USA); Stanford Univ., CA (USA). Stanford Electronics Labs.). 1984. Contract FG02-84ER45091;AC02-81ER10908;AC02-76CH00016. 5p. (CONF-840764—6). NTIS, PC A02/MF A01; GPO Dep. File Number DE85001354.

From 3. international EXAFS conference; Stanford, CA, USA (16 Jul 1984).

The first definitive measurements of EXAFS by monitoring the direct photoelectron emission as a function of photon energy have been made using the Mn 3p and F 2s core levels in evaporated films of MnF_2. Good agreement is found with bulk transmission EXAFS obtained with the Mn 1s level. This development is important because: (1) almost all elements have suitable core levels of low binding energy; (2) since photopeaks from adjacent core levels do not cross as the photon energy is varied, the limitation imposed on other EXAFS techniques by this interference is removed. Auger electrons, which have fixed kinetic energies and so can cross photopeaks, will generally have low energies if they originate from the outer core levels and be unlikely to appear in the EXAFS region of kinetic energies, i.e., in excess of about 50 eV; (3) vuv light is used, which greatly extends the useable range of photon energies; and (4) more than one element in a solid may be studied with the same monochromator. In this work all diffraction effects except the backscattering that gives rise to the EXAFS were eliminated by using a polycrystalline evaporated thin film and by making use of the 2π azimuthal acceptance angle of a cylindrical mirror analyzer. Previously MARGARITONDO and coworkers observed EXAFS-like oscillations in photopeaks as a function of photon energy when a CMA was used; however, their data did not extend over a sufficient photon energy range to prove conclusively that EXAFS was involved.

48633 **(CONF-840449—13) Experiments on statistical mechanics using resonance ionization spectroscopy.** Iturbe, J.; Allman, S.L.; Hurst, G.S.; Payne, M.G. (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85001892.

From 2. symposium on resonance ionization spectroscopy and its applications; Knoxville, TN, USA (16 Apr 1984).

Five different fluctuation phenomena at the atomic and molecular levels have been studied by resonance ionization spectroscopy techniques with one-atom detection sensitivity. The Poisson distribution described the observed frequency distributions suggesting random behavior. In addition, a gedanken experiment suggested by Einstein and Furth on the diffusion of atoms was performed in order to test the equality between time and ensemble averages. The obtained results confirmed the ergodicity of the studied system.

48634 **(CONF-8404190—2) Confinement of low-energy electrons near metallic surfaces for plasmon generation.** Warmack, R.J.; Ferrell, T.L.; Ritchie, R.H.; Becker, R.S.; Mamola, K.C.; Buncick, M.C.; Hubbell, H.H.; Birkhoff, R.D. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 15p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85001119.

From Warner-Brandt workshop on penetration phenomena: in elastic near-surface interaction; Oak Ridge, TN, USA (12 Apr 1984).

A novel technique is used in studying the energy loss spectrum of aloof (nontouching) electrons with surfaces. Metallic foils perforated by microchannels restrict the maximum impact parameter to the channel radius (20 to 200 nm). The passage of electrons (20 to 2000 eV) near the cylinder walls results in prominent energy-loss structure. In silver, a resonance loss peak at 3.5 to 3.6 eV is attributed to the formation of surface plasmons on the silver channels. The problem is modeled by a classical calculation of a charge moving parallel to a plane surface whose response is given by tabulated optical properties. The differential probability is calculated assuming the lower limit to the impact parameter is determined by surface roughness. The calculations are compared with the experimental data.

48635 **(DOE/ER/10371—6) Negative ion detachment cross sections. Progress report, March 1, 1982-February 28, 1985.** Champion, R.L.; Doverspike, L.D. (College of William and Mary, Williamsburg, VA (USA). Dept. of Physics). Aug 1984. Contract AS05-79ER10371. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85001337.

The purpose of the experimental investigations undertaken during the past three years was to perform an extensive and comprehensive study of the collisional dyanmics of reactants which involve collisions of negative ions and neutral molecular targets. The (laboratory) collision energy for these studies ranged from about 1 eV up to 500 eV and the experiments involved measurements of both absolute total cross sections and doubly-differential cross sections. The various processes investigated included electron detachment, charge transfer, dissociative charge transfer and reactive (or rearrangement) scattering. Reactants which were the subjects of these investigations included the negative ions H^-, D^-, O^- and selected halogen anions in collisions with H_2, D_2, HD, O_2, N_2, CO, CO_2, CH_4 and several methyl halides.

48636 **(DOE/ER/10618—11) Description of an atomic structure software package.** Fischer, C.F. (ed.). (Vanderbilt Univ., Nashville, TN (USA). Dept. of Computer Science). May 1983. Contract AS05-80ER10618. 90p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85002081.

The MCHF method has been shown to be effective for the study of correlation and for croblems where relativistic effects are small. It has been applied to some difficult cases where a perturber is embedded in a Rydberg series and mixing depends critically on correlation. Relativistic corrections may be included through the Breit-Pauli approximation. This approach has been used recently in a study of the Boron sequence where the fine structure splitting obtained from multiconfiguration Dirac-Hartree-Fock calculations was not in good agreement with observation and a correction process was needed. It has also been used to study forbidden transitions in the Carbon, Nitrogen, and Oxygen sequence. Thus the MCHF (or MCHF+BP) method is a versatile method for the study of atomic structure for a large class of problems. The present software package is based on this method.

48637 **(DOE/ER/10618—13) Theoretical studies of atomic transitions. Progress report, March 15, 1982-March 14, 1985.** Fischer, C.F. (Vanderbilt Univ., Nashville, TN (USA)). Sep 1984. Contract AS05-80ER10618. 21p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85001325.

Allowed and forbidden transitions have been studied for a number of atomic systems, of interest in fusion research, using the multiconfiguration Hartree-Fock method with relativistic corrections in the Breit-Pauli approximation. To perform these studies, an atomic structure software package has been designed with computers such as the VAX 11/780 in mind. Numerical procedures are being developed which will extend the program capability to continuum functions which arise in photo-ionization calculations. Extensive studies have been performed of fine-structure splittings and transition rates (E2 and M1) for the ground configurations of the Boron, Nitrogen and Oxygen sequences within the MCHF + BP approximation. Allowed 2s → 2p transitions for the latter were also considered. Calculations for the Carbon sequence are in progress. In an attempt to improve the level of accuracy for few electron systems, programs were developed which would include the mass polarization correction, arising from the finite mass of the nucleus. A revised MCHF program has removed the restriction on the l-quantum number. Some preliminary results for He and Li II have been obtained. Unlike many studies which report results for an isoelectronic sequence, thereby providing fragments of information about a number of spectra, moderately accurate calculations of energy levels and lifetimes were performed for a large portion of a single spectrum. Some 30 quartet levels of Be II were determined. This lead to the identification of a number of lines that had been observed in fast-ion beam experiments.

48638 **(DOE/ER/40001—38) Optically pumped polarized ^{23}Na vapor target for use in polarized ion source. Technical progress report.** Anderson, L.W. (Wisconsin Univ., Madison (USA). Dept. of Physics). 1984. Contract AC02-81ER40001. 44p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE84017573.

We are currently measuring relaxation times in an optically pumped ^{23}Na vapor target. Our research is directed toward improvements in the optically pumped Na vapor targets used for the production of polarized H^- ions. In this progress report we review the properties of the optically pumped polarized H^- ion source and especially the optically pumped Na vapor target employed in this source as well as discussing the progress of our research on relaxation times in an optically pumped Na vapor target. 30 references, 6 figures, 3 tables.

48639 **(DOE/PR/06010—T34) Atomic and molecular collision processes. Progress report.** Norcross, D.W. (Joint Inst. for Lab. Astrophysics, Boulder, CO (USA)). 30 Jul 1984. Contract AI01-76PR06010. 8p. NTIS, PC A02/FM A01; 1; GPO Dep. File Number DE85001604.

Recent progress, and planned work, in a long-term program of code development and high precision calculations for electron collisions with atoms, atomic ions, and molecules is summarized. In electron-ion collisions, we are primarily concerned with the fundamental physics of the process that controls excitation in high temperature plasmas. In the molecular work, one interim goal is a capability for accurate calculations of ro-vibrational excitation of polyatomic molecules by electrons; the ultimate objective is a capability for specification of continuum states of electron-molecule systems for use in calculations of dynamical processes, e.g., associative-detachment and dissociative-attachment.

48640 (FNAL/C—84/68-E) **Achieving cold antiprotons in a Penning trap.** Kells, W.; Gabrielse, G.; Helmerson, K. (Fermi National Accelerator Lab., Batavia, IL (USA); Washington Univ., Seattle (USA). Dept. of Physics). Aug 1984. Contract AC02-76CH03000. 13p. (CONF-840786—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84016719.

From 9. international conference on atomic physics; Seattle, WA, USA (23 Jul 1984).

The current state of proton/electron trapping sensitivity at Washington requires only small numbers ($\leqq$ 100) of anti p be trapped in order to achieve high signal to noise ratios. We therefore investigated a anti p trapping scheme based on stopping foils which, in the simplest case, require no auxiliary decelerator/cooler past a LEAR (or equivalent) stage. Cooling of the trapped particles could be accomplished via the damping provided by an external resistor as in all of the other experiments. The rate of this cooling would be rather low, even in the most ideal case, and likely would be much lower when the electrostatic anharmonicity of such a trap is realistically considered. We thereby examined a possible alternate cooling scheme, electron cooling with a buffer gas of cold electrons, in order to improve the cooling rate. 18 references.

48641 (FRNC-TH—1408) **Performance evaluation of various types of ion sources capable of delivering monoenergetic beams of about ten mA at several keV in a spatial environment (H.F. source, microwave source, duoplasmatron).** Hajlaoui, B.Y. (Orleans Univ., 45 (France)). Oct 1983. 182p. (In French). NTIS (US Sales Only), PC A09/MF A01. File Number DE84751760.

This study of a ion source has been made by taking in account weight, volume, power and environment constraints imposed by a space flight. First, a HF ionization source has been tentatively adapted, this inductively coupled source study is the first part of this work. Afterwards, an entirely new source has been realised; a system which allows to produce a plasma by wave surface (surfation) excitation has been used for it. The microwave ionization source performance has been defined and a space condition adapted prototype built. The last part of the thesis is the two source parameter comparison with a duo-plasmatron. This ion gun is considered as a reference.

48642 (INIS-mf—8865) **Hyperfine structure investigations for the determination of the nuclear quadrupole moment of the shortlived nuclide Cu^{60} by resonance scattering of light.** Krellmann, H. (Technische Univ. Berlin (Germany, F.R.). Fachbereich Physik). 11 Nov 1982. 146p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE84780565.

The nuclide Cu^{60} was produced at the Berlin Cyclotron at 16,5 MeV by bombarding a thick target of 99.99% Ni. After heating the target, Cu atoms, being diffused to the surface and evaporated to an atomic beam, were excited by a light source of natural copper. The hyperfine structure was investigated by levelcrossing technique, using single photon counting and a lock-in system with sinusoidal modulation. The measured changes of intensity of the 324 nm resonance line as a function of an external magnetic field can be described well by a fitted hfs- B-factor taking into account the known A-factor.

48643 (LBL—18143) **Spectroscopy of one- and two-electron uranium.** Gould, H. (Lawrence Berkeley Lab., CA (USA)). Aug 1984. Contract AC03-76SF00098. 13p. (CONF-840788—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE84016887.

From International conference on the physics of highly ionized atoms; Oxford, UK (2 Jul 1984).

The spectra from n = 2 → = 1 transitions of hydrogenlike and heliumlike uranium have been observed. Possible experiments to study quantum electrodynamics in these systems are discussed.

48644 (PB—84-206309) **Spectroscopy and chemistry of muonium.** Cox, S.F.J. (Rutherford Appleton Lab., Chilton (UK)). 1984. 55p. (RL—83-114). NTIS, PC E04/MF E04.

The special significance of muonium in atomic and molecular physics is explained, and its utility as a lightweight or radioactive isotope of hydrogen in solid state physics and chemistry illustrated. The experimental study of muonium, principally by means of Muon Spin Rotation and Resonance, is introduced; this is compared and contrasted with the study of unbound muons by these techniques. The identification of atomic muonium by means of its ground state magnetic properties is described with reference to the Breit-Rabi diagram. The precession signals observed in transverse-field MuSR correspond to transitions allowed between the energy levels in this diagram; particular attention is paid to the spectra characteristic of the high and low field regimes. The different states of muonium observed in dielectric, semiconducting and metallic materials are introduced. The physical processes by which implanted muons lose their excess kinetic energy and become thermalized in liquid and gaseous media are described and the different chemical species formed as products of these processes enumerated. There are various hypotheses as to how muonium itself is formed; the evidence in favor of each of these is presented. The factors which determine the proportion of muonium which may be observed in the atomic state, the proportion which is bound in diamagnetic molecules, and the proportion which may not be directly visible in the MuSR spectra, are considered.

48645 (PB—84-206325) **Spectral intensities from hydrogen-like ions.** Ljepojevic, N.N.; Hutcheon, R.J.; McWhirter, R.W.P. (Rutherford Appleton Lab., Chilton (UK)). 1984. 38p. (RAL—84-017). NTIS, PC E03/MF E03.

In this paper the authors describe a collisional-radiative calculation for hydrogen-like ions of nuclear charge less than about 15. Separate account is taken of the (n,l,j) sub-levels up to and including n=4 so that the results of the calculation may be used to predict the intensities of the fine structure components of the corresponding transitions. In particular we present calculated intensity ratios for the Lyman alpha components (1S(1/2)-2P(1/2) and 1S(1/2)-2P(3/2)) for comparison with the recent observations of these resolved components seen from solar flares and tokamak plasmas. The calculation also gave numerous values of various excitation, recombination and ionization rate coefficients and some of these are presented by comparing the new results with values derived previously and already published. The differences are shown to arise partly from the new (and we believe better) choice of basic atomic data and partly because we have treated the (n,l,j) levels separately. (Copyright (c) Science and Engineering Research Council 1984.)

48646 **Scaling of collisionally pumped 3s-3p lasers in the neon isoelectronic sequence.** Feldman, U.; Seely, J.F.; Bhatia, A.K. (E. O. Hulburt Center for Space Research, Naval Research Laboratory, Washington, DC 20375). *Journal of Applied Physics;* **56**: No. 9, 2475-2478(1 Nov 1984).

Population inversions between the 3p and 3s levels of neonlike ions with atomic numbers Z = 14, 18, 22, 26, 32, and 36 have been calculated. The population inversions result from the preferential population of the 3p level by electron collisional excitation from the ground configuration of the ion and occur over a wide range of electron temperature and electron density (from 10^{17} cm^{-3} for Si V to 10^{22} cm^{-3} for Kr XXVII). For all ions that are studied, the maximum value of the population inversion (N/sub 3p//g/sub 3p/-N/sub 3s//g/sub 3s/) for the transition 3p $^1S_0$-3s /sup u/P_1 (where u represents the upper of the singlet and triplet levels) is found to be approximately equal to 4 x 10^{-3} N/sub I/, where N/sub I/ is the total density of neonlike ions. With the exception of Si V, laser gains greater than 1 cm^{-1} are possible for all the ions that are considered, and the gain increases with atomic number Z. For Si V and lower-Z ions, electron collisional mixing of the upper and lower laser levels restricts the electron density at which the population inversion occurs and limits the laser gain to values less than 1 cm^{-1}. The scaling of the laser gain and the plasma parameters with atomic number Z is presented. For an electron density of 10^{21} cm^{-3}, the optimum atomic number Z that results in the highest gain on the 3p $^1S_0$-3s /sup u/P_1 transition is Z = 26 (Fe XVII), and the gain is equal to 30 cm^{-1}.

48647 Three-body dissociation of triatomic hydrogen molecular ions. Alvarez, I.; Cisneros, C.; de Urquaijo, J.; Morgan, T.J. (Instituto de Fisica, Universidad Nacional Autonoma de Mexico, 01000 Mexico, Distrito Federal, Mexico). *Physical Review Letters;* **53**: No. 7, 740(13 Aug 1984).

A Comment on the Letter by D. L. Montgomery and D. H. Jaecks, Phys. Rev. Lett. 51, 1862 (1983).

48648 Electron and positive ion emission accompanying fracture of Wint-o-Green Lifesavers and single-crystal sucrose. Dickinson, J.T.; Brix, L.B.; Jensen, L.C. (Washington State Univ., Pullman). *Journal of Physical Chemistry;* **88**: No. 9, 1698-1701(26 Apr 1984).

It is a well-known fact that, when Wint-o-Green Lifesavers (Lifesaver is a registered trademark of Lifesaver, Inc.) are broken in air, one observes intense triboluminescence. Measurements of the emission of electrons and positive ions from the fracture of these Lifesavers under vacuum, as well as from single-crystal sucrose are reported herein. The emission of photons and radio waves during fracture under vacuum is also presented for sucrose, indicating the occurrence of a gaseous discharge in the crack tip during crack growth. Comparisons of the various emission curves are presented and discussed in terms of stress-induced charge separation.

48649 Possibility of studying crystal field levels and excitations by μiSR spectroscopy. Yaouanc, A. (Los Alamos National Lab., NM (USA)). *Hyperfine Interactions;* **17**: No. 1-4, 355-357(Jan 1984). (CONF-830455—).

From Yamada conference on muon spin rotation and associated problems; Shimoda, Japan (18 Apr 1983).

The author points out that μ^+SR relaxation times T_1 and T_2 measured in metallic magnetic materials can sometimes be expressed in terms of the spin-spin correlation functions of the magnetic ions. He calculates these functions in a random phase approximation and notices they can strongly depend on the crystal field levels and excitations of the magnetic ions. The shortcomings of this approximation are discussed.

48650 Muon spin rotation experiments on a silicon crystal doped with ^{13}C. Estle, T.L. (Rice Univ., Houston, TX (USA). Dept. of Physics); Blazey, K.W. (IBM Research Lab., Zurich (Switzerland)); Boekema, C.; Heffner, R.H. (Los Alamos National Lab., NM (USA)). *Hyperfine Interactions;* **18**: No. 1-4, 615-617(Jan 1984). (CONF-830455—).

From Yamada conference on muon spin rotation and associated problems; Shimoda, Japan (18 Apr 1983).

A crystal of silicon doped with carbon enriched to 60.1% in ^{13}C was studied by μSR to determine whether ^{13}C hyperfine structure could be observed in the frequency spectra of normal muonium, Mu, or anomalous muonium, Mu*. Measurements at 100 G and 100 K with 40 million good events yielded extremely weak Mu* signals and no Mu in these data or in measurements at 10 G and 150 K. Transmission electron micrographs of this sample contained small regions showing strain contrast and structure factor contrast. Annealing the sample at 900°C for 84 hours led to featureless electromicrographs. Subsequent μSR measurements yielded a strong Mu* signal but still no Mu. No broadening due to ^{13}C was observed.

48651 Absorptivity of nitric oxide in the fundamental vibrational band. Holland, R.F.; Vasquez, M.C.; Beattie, W.H.; McDowell, R.S. (Los Alamos National Lab., Los Alamos, NM). *Journal of Quantitative Spectroscopy and Radiative Transfer;* **29**: 435-438(May 1983).

From observations of the spectral absorbance of mixtures of nitric oxide in nitrogen at room temperature, an integrated absorptivity for the NO fundamental band of 137.3 + or - 4.6 per(sq cm atm) at 0 C is derived. The indicated uncertainty is the estimated maximum error.

48652 Investigation of the dynamics and threshold behavior of negative ion-neutral reactions. Tiernan, T.O.; Wu, R.L.C.; Ichikawa, Y. (Wright State University, Dayton, OH). pp 18.2.1-18.2.3 of Annual mini-symposium on aerospace science and technology. New York, NY, USA; American Institute of Aeronautics and Astronautics (1983). (CONF-8303170—). Contract AC02-80ER10668.

From 9. annual mini symposium on aerospace science and technology; Wright Patterson AFB, OH, USA (22 Mar 1983).

The important upper atmosphere negative ion-molecule interaction, O(-)+H2(D2)-OH(-)(OD(-))+H(D), has been extensively studied using a tandem mass spectrometer and a crossed ion-molecular beam apparatus. Total cross sections for this reaction were measured as a function of ion kinetic energy, over the range, 0.03-4 eV. The product ion angular and energy distributions were also measured in the relative energy range from 1.1 to 2.5 eV. With increasing interaction energy, the centers of the product distributions were observed to move forward with respect to the center of mass, indicating that long-lived intermediate complex formation does not occur at higher energies. 14 references.

6404 Fluid Physics

REFER ALSO TO CITATION(S) 64041048001

48653 (AD-A—141508/2) Hyperbolicity and change of type in the flow of viscoelastic fluids. Technical summary report. Joseph, D.D.; Renardy, M.; Saut, J.C. (Wisconsin Univ., Madison (USA). Mathematics Research Center). Mar 1984. 57p. NTIS, PC A04/MF A01.

Prepared in cooperation with Grants NSF-MCS79-27062, NSF-MCS82-10950 and NSF-MCS82-15064.

The equations governing the flow of viscoelastic liquids are classified according to the symbol of their differential operators. Propagation of singularities is discussed and conditions for a change of type are investigated. The vorticity equation for steady flow can change type when a critical condition involving speed and stresses is satisfied. This leads to a partitioning of the field of flow into subcritical and supercritical regions, as in the problem of transonic flow.

48654 (UCRL—90831) Modal analysis applied to the DAA model for fluid structure interaction in underwater shock. Ginsberg, J.H.; Rosenkilde, C.E. (Lawrence Livermore National Lab., CA (USA)). Aug 1984. Contract W-7405-ENG-48. 24p. (CONF-8409131—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85001750.

From EUROMECH 188 meeting; Leeds, UK (24 Sep 1984).

Past studies of the response of cylindrical types of pressure vessels to underwater shock waves have treated relatively simple cases of incidence, such as broadside. The present study develops a general algorithm for shock response in which a variety of effects can be described in modular form. The concept is then used to investigate a case of oblique incidence. The overall technique employs the doubly asymptotic approximation (DAA) of fluid-structure interaction, but in the less well-known modal expansion form. A general procedure is outlined. In it, the modes of free vibration of each structural component are used as a group of basis functions. Each group is derived for the condition where the structural motion associated with the other groups is not present. In addition to modes for the structural motion, DAA requires a selection of surface expansion functions for the fluid response. These functions are often referred to as fluid modes. Relatively simple criteria for these functions are developed based on consistency with the choice of structural modes. These criteria lead to general statements regarding the corresponding coupling between the fluid and structural modes. It is shown that the manner in which the modal generalized coordinates couple in this scheme greatly enhances the efficiency of the computational algorithm. The combination of this feature and the fact that modal expansion techniques generally involve a comparatively small number of degrees of freedom makes the procedure very attractive for numerical analysis.

6450 High Energy Physics

40655 Prospects for polarized electrons at high energies. Prescott, C.Y. (Stanford Linear Accelerator Center, Stanford Univ., Stanford, CA 94305). pp 415-446 of The high-energy limit. Vol. 18. Zichichi, A. New York, NY, USA; Plenum Publishing Corp. (1983). (CONF-800778—).

From 18. course: the high energy limit; Erice, Trapani, Italy (31 Jul 1980).

Neutral current and electroweak processes at high energies are well known to have large spin-dependent components. Proven techniques for producing polarized beams at storage rings and linear accelerators are now available. It is argued that use of polarized electrons in $e^- e^+$ annihilation at the Z^0 pole and above will provide the most precise tests of, and best experimental challenge to, the standard SU(2) X U(1) gauge theory model of electroweak interactions.

6451 Particle Interactions And Properties - Experimental

40656 (ANL-HEP-CP—84-54) Some experimental considerations of the QCD Group. Fields, T.H.; Albrow, M.G.; Boggild, H. (Argonne National Lab., IL (USA); Rutherford Appleton Lab., Chilton (UK); Niels Bohr Inst., Copenhagen (Denmark)). 1984. Contract W-31-109-ENG-38. 7p. (CONF-840275—12). NTIS, PC A02/MF A01; GPO Dep. File Number DE84016317.

From Workshop on anti pp options for the SSC; Chicago, IL, USA (13 Feb 1984).

For experimental investigation of quantum chromodynamics, the preferred machine question is dominated by such issues as how much luminosity is needed and which machine is practical (to get approved, build fast, run reliably, etc.). It is concluded that pile-up problems for localized E/sub T/ triggers are not serious. For high luminosity QCD studies a philosophy is envisaged which is predominantly calorimetric and ignores the low p/sub t/ activity. It is suggested that consideration be given to the concept of a jet spectrometer for jet fragmentation with momentum measurement. (LEW)

40657 (BNL—35060) Concluding remarks and outlook: Europhysics conference on flavor-mixing in weak interactions. Chau, L.L. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 10p. (CONF-8403113—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE84015725.

From Europhysics conference; Erice, Italy (4 Mar 1984).

Some comments are offered on the present knowledge of the mixing matrix of Kobayashi and Maskawa and of the dynamics of nonleptonic decay. Also, remarks are made concerning CP violation. Plans for research from 1984 to 1989 are listed briefly. The history of studies on weak interactions is briefly reviewed, and several unanswered questions are stated, such as where are the truth particles, how may they be discovered, what is the mass-generating mechanism for the gauge bosons, how many Z^0's and W's are there, do neutrinos have mass, and how long do protons live. (LEW)

40658 (BNL—35086) Status of rare decay experiments. Littenberg, L.S. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 35p. (CONF-8403113—5). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE84016435.

From Europhysics conference; Erice, Italy (4 Mar 1984).

Some results are given for rare muon decay experiments currently running. Also, plans are discussed for rare kaon decay experiments. Some of the events sought come from processes which violate lepton flavor conservation. Several apparatuses used in the search are described. 35 references. (LEW)

40659 (BNL—35087) Measurement of ϵ' at the AGS. Morse, W.M. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 10p. (CONF-8403113—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84016445.

From Europhysics conference; Erice, Italy (4 Mar 1984).

The principle of the precision measurement of ϵ'/ϵ is to observe the pi$^+$ p$^-$ and pi^{0}pi^0 decay modes of both the K^0/sub L/ and K^0/sub S/ in one experiment. It is expected that approximately five thousand K^0/sub L/ → pi^{0}pi^0 events will be accumulated in six hundred hours of data taking. The data taken thus far yield the result of $\epsilon'/\epsilon = 0.012$ +- 0.015, consistent with the superweak theory and the standard model calculation. (LEW)

40660 (BNL—35106) Summary of the working group on penetrating probes in collider experiments. Ludlam, T. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 15p. (CONF-8403137—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84016990.

From Workshop on detectors for relativistic nuclear collisions; Berkeley, CA, USA (26 Mar 1984).

The penetrating probes are discussed for detection and measurement of signals which carry information directly from the interior of a quark-gluon plasma. These probes include muons, electron pairs, photons, and, at very high energies, jets. Research needed in the area of the detectors required for these measurements, specifically charged particle tracking detectors, is discussed. (LEW)

40661 (BNL—35170) Some thoughts on searches for proton decay. Goldhaber, M. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 6p. (CONF-8403113—6). NTIS, PC A02/MF A01; GPO Dep. File Number DE84016988.

From Europhysics conference; Erice, Italy (4 Mar 1984).

It is recalled that the minimal SU(5) theory appears to be contradicted by proton decay lifetimes longer than predicted. However, it has been pointed out that final state interaction due to strong meson field couplings may suppress proton decay. Events have been detected which include proton decay candidates. The need for reproducibility and for consistency checks is discussed. It is tacitly assumed that one decay product should be an anti-lepton. Unless there are special selection rules, two-body decays would be expected to predominate from phase space considerations. (LEW)

40662 (DOE/ER/04449—45) Study of the neutron-proton interaction in the 300-700 MeV energy region. Annual progress report, 1983-1984. Northcliffe, L.C. (Texas A and M Univ., College Station (USA)). 1984. Contract AS05-76ER04449. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85001907.

The principal activities have included four months of data taking to complete LAMPF Experiment 665 (The Measurement of the Initial State Spin Correlation Parameters C/sub LL/ and C/sub SL/ in n-p Elastic Scattering at 500, 650 and 800 MeV) and preparations for LAMPF Experiment 770 (The Measurement of np Elastic Scattering Spin Correlation Parameters with L- and S-Type Polarized Beam and Target Between 500 and 800 MeV), which is similar to 665 but involves different target orientations and a different angular region.

40663 (DOE/ER/05023—3) Neutral-current x-distributions. Bogert, D.; Burnstein, R.; Fisk, R.; Fuess, S.; Bofill, J.; Busza, W.; Eldridge, T.; Friedman, J.I.; Abolins, M.; Brock, R. (Fermi National Accelerator Lab., Batavia, IL (USA); Massachusetts Inst. of Tech., Cambridge (USA); Michigan State Univ., East Lansing (USA)). Jun 1984. Contract AC02-78ER05023. 19p. (CONF-8406182—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84016522.

From 11. international conference on neutrino physics and astrophysics; Nordkirchen bei Dortmund, F.R. Germany (11 Jun 1984).

The role of the semi-leptonic neutral current interaction as a probe of nucleon structure is examined. Previous measurements of neutral current x-distributions are reviewed, and new results from the Fermilab - MIT - MSU collaboration are presented. 4 references.

48664 **(DOE/ER/05023—T2) Study of the weak neutral current at the Tevatron. Technical progress report.** Taylor, F.E. (Fermi National Accelerator Lab., Batavia, IL (USA)). 23 Aug 1984. Contract AC02-78ER05023. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85001627.

The Flash Chamber - Proportional Tube Calorimeter has been used to study the weak neutral current in deep inelastic scattering at the 400 GeV FNAL Accelerator and it will be used at the Tevatron to extend the energy range of these measurements. The effort of this contract during the last year has been concentrated in three areas: (1) analysis of the 400 GeV Narrow Band Neutrino Beam Data taken in the experiment E-594 at Fermilab; (2) upgrade of the detector in preparation for the two experiments scheduled for the Tevatron; and (3) calibration of the detector up to Tevatron energies. This report describes the work in progress on these subjects.

48665 **(DOE/ER/13065—388) Summary of neutrino and lepton structure functions.** Bodek, A. (Rochester Univ., NY (USA). Dept. of Physics and Astronomy). 1984. Contract AC02-76ER13065. 11p. (COO—3065-388; CONF-8406158—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84014892.

From Intersections between nuclear and particle physics conference; Dortmund, F.R. Germany (1 Jun 1984).

A brief summary is given of high statistics experiments and selected structure function results are given. (LEW)

48666 **(DOE/ER/13065—395) Determination of sin²Θ/sub w/ and rho in nu/sub μ/-Fe and anti nu/sub μ/-Fe interactions.** Bodek, A.; Reutens, P.; Merritt, F.; Blair, R.; MacFarlane, D.; Messner, R.; Novikoff, D.; Purrohit, M.; Sciulli, F.; Shaevitz, M. (Rochester Univ., NY (USA)). 19 Jul 1984. Contract AC02-76ER13065. 3p. (CONF-840757—11). NTIS, PC A02/MF A01; GPO Dep. File Number DE85002075.

From 22. international conference on high energy physics; Leipzig, German D.R. (19 Jul 1984).

We have extracted the electroweak parameters sin²Θ/sub w/ and rho from deep inelastic nu/sub μ/-Fe and anti nu/sub μ/-Fe data taken with the Fermilab narrow band neutrino beam. These parameters were extracted using the Paschos-Wolfenstein ratios for charged current (CC) and neutral current (NC) events. A novel feature of this analysis was the imposition of radius dependent cuts in the kinematic variable y, which reduced the systematic and total errors. Results are given. (WHK)

48667 **(DOE/ER/70149—T3) High energy physics study. Final report.** Schultz, J.; Mandelkern, M.A. (California Univ., Irvine (USA). Dept. of Physics). 1984. Contract AT03-76ER70149. 22p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84015803.

A final report is presented on activities of the Experimental High Energy Physics Group at the University of California, Irvine, prior to its merger (as Task B) with the UCI Neutrino Group under a single contract. The report deals primarily with the earlier antiproton bubble chamber experiments performed by the group, and with the more recent counter experiments performed at Brookhaven National Laboratory and CERN to search for bound and resonant states in the nucleon-antinucleon system. 44 references.

48668 **(LBL—17899) New results on flavor production at PEP.** Barbaro-Galtieri, A. (Lawrence Berkeley Lab., CA (USA)). May 1984. Contract AC03-76SF00098. 45p. (CONF-8403113—2). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE84014589.

From Europhysics conference; Erice, Italy (4 Mar 1984).

This report includes results from five PEP detectors: DELCO, HRS, MAC, MARK II and TPC. All, except the TPC, are presently taking data at PEP. The TPC is being upgraded: a new superconducting coil is being installed and other improvements are being implemented. The results discussed here are either new or improved since the Cornell Conference. New results on Particle Searches and a limit on neutrino generations are discussed. New data are included on weak couplings of c and b quarks. Various new results on hadron production are reported. All data were obtained in e^{+-} collisions with total energy $\sqrt{s}=29$ GeV. 54 references.

48669 **(LBL—17930) J/psi physics at BEPC.** Chanowitz, M.S. (Lawrence Berkeley Lab., CA (USA)). Jun 1984. Contract AC03-76SF00098. 54p. (CONF-8406184—3). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE84016897.

From 1. workshop on colliding beam physics in China; Beijing, China (12 Jun 1984).

J/psi physics is discussed which will be of interest at T > 1988, the period of operation of the Beijing Electron Positron Collider. Emphasis is placed on the gluonic states which are best studied in radiative J/psi decay. The difficulties of these studies are discussed and the need for very high statistics is stressed. In particular it is essential to partial-wave-analyze the hadronic final states produced in J/psi $\rightarrow \gamma X$. An estimate using fixed target data suggests that $0(10^8)$ J/psi decays are needed to do an unambiguous partial wave analysis for hadron masses up to about 2 GeV. This requirement is an excellent match to the BEPC design parameters, which imply production of $0(10^8)$ J/psi's per year. With a J/psi production rate an order of magnitude greater than other electron-positron storage rings, BEPC will be a unique world facility for these studies. 58 references.

48670 **Forward-backward particle correlation measurements in proton-carbon collisions at 2.1 GeV.** Treuhaft, R.N.; Geaga, J.V.; Koontz, R.; Pugh, H.G.; Roche, G.; Schroeder, L.S.; Ruiz, C.L.; Engelage, J.; Kirk, P.N.; Krebs, G. (Nuclear Science Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review* [*Section*] *C: Nuclear Physics;* **30**: No. 2, 616-632(Aug 1984). Contract AC03-76SF00098;AS05-76ER04699.

A (p,2p) experiment was carried out at 2.1 GeV to search for interactions between the incident proton and a fast dinucleon constituent inside the target nucleus. The results of this experiment along with a Two-Armed Spectrometer System used to make these coincidence measurements are described. Data are presented that indicate a possible contribution to the backscattered proton spectrum from such a dinucleon structure, although effects of statistics and experimental resolution allow only an upper limit to be set on the magnitude of this contribution. Effects of phase space, Fermi motion, and final state interactions on these measurements are discussed. A comparison with an intranuclear cascade model is shown. The systematics of other two-particle coincidence spectra obtained in this experiment are also presented.

48671 **Experimental search for narrow resonances in the reaction πpp -> $\gamma\gamma$n at 13 GeV/c.** Chiang, I.H.; Johnson, R.A.; Kwan, B.P.; Kycia, T.F.; Li, K.K.; Littenberg, L.S.; Wijangco, A.R.; Halling, A.M.; Hogan, G.E.; Lu, C.G. (Brookhaven National Lab., Upton, NY). *Physics Letters,* [*Section*] *B;* **140**: No. 1/2, 145-148(31 May 1984).

Using a double arm electromagnetic calorimeter we have searched for narrow states produced in the exclusive reaction π^- p -> $\gamma\gamma$n at 13 GeV/c. No enhancements were observed in the mass range 2.0-4.0 GeV/c². For example, the 90% confidence limit on etasub(c) production is sigma (π^- p -> etasub(c)n) x B (etasub(c) -> $\gamma\gamma$) < 44 pb.

48672 **Measurement of antipp and pp elastic scattering at the ISR.** Meyer, W.T. (Ames Laboratory, Ames, IA (USA)). pp 65-72 of Antiproton proton physics and the W discovery. Proceedings of 3. Moriond workshop. Tran Thanh Van, J. (ed.). Gif-sur-Yvette, France; Editions Frontieres (1983). (CONF-830377—).

From 18. Recontre de Moriond conference. 3. Moriond workshop; La Plagne, France (19 Mar 1983).

Preliminary results for antipp and pp elastic scattering differential cross sections are presented for the interval $0.1</t/<0.9$ $(GeV/c)^2$ at the three energies $\sqrt{s}=31$, 53, and 62 GeV. Fits to the data were used to determine the slope parameters. The data were taken with the Split Field Magnet Detector at the CERN Intersecting Storage Rings.

48673 **Analysis of forward and near forward elastic scattering amplitudes for pp and antipp collisions.** Block, M.M. (Northwestern University, Evanston, IL (USA)); Cahn, R.N. (Lawrence Berkeley Laboratory, Berkeley, CA (USA)). pp 95-105 of Antiproton proton physics and the W discovery. Proceedings of 3. Moriond workshop. Tran Thanh Van, J. (ed.). Gif-sur-Yvette, France; Editions Frontieres (1983). (CONF-830377—).

From 18. Recontre de Moriond conference. 3. Moriond workshop; La Plagne, France (19 Mar 1983).

We present the results, which analyze for antipp and pp elastic scattering the rho values (ratios of the real to the imaginary parts of the forward nuclear scattering amplitudes), the total (hadronic) cross sections sigma, the b values, and nuclear slope parameters. The predictions of the analyses, from $\sqrt{s}>5$ GeV, is compared with the recently measured values of sigma and b at the SPS collider. The analysis has also been redone to include new ISR data available from R211 at $\sqrt{s}=62.5$ GeV, in order to estimate "odderon" contributions, i.e., contributions from odd amplitudes with unconventional (non-Reggeon) energy dependence. Limits of approximately 1% are placed on these amplitudes. Our analysis has been extrapolated up to 100 Tev, to give sigma, rho and b predictions for cosmic ray and future collider energies.

6452 Particle Interactions And Properties - Theoretical

REFER ALSO TO CITATION(S) 64520048657, 48669, 48686, 48696, 48696, 48699, 48772

48674 **(DOE/ER/01545—347) Comments on the EMC effect.** Tanaka, K. (Ohio State Univ., Columbus (USA). Dept. of Physics). 1984. Contract AC02-76ER01545. 9p. (CONF-8405236—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84016153.

From 7. symposium on elementary particle physics; Kazimierz, Poland (21 May 1984).

The scaling model and cluster model descriptions of the deep inelastic scattering structure functions are discussed. 14 references.

48675 **(DOE/ER/04449—52) Search for possible 6-q states via inclusive reactions.** Bhatia, T.S. (Texas A and M Univ., College Station (USA)). 1984. Contract AS05-76ER04449. 6p. (CONF-8405193—43). NTIS, PC A02/MF A01; GPO Dep. File Number DE85001909.

From Conference on the intersections between particle and nuclear physics; Steamboat Springs, CO, USA (23 May 1984).

A satisfactory understanding of the 6-q system is necessary for a complete understanding of the short-range part of the NN interaction. Bag models and quark potential models predict 6-q states in the 2 to 3 GeV mass range. $NN\pi$ and $NN\pi\pi$ are examples of 6-q states involving the same quark flavors as the NN system, search for which could be undertaken through inclusive spin-dependent measurements.

48676 **(DOE/ER/40008—59) Computing the Kac determinant using dual model techniques and more about the No-ghost theorem.** Thorn, C.B. (Florida Univ., Gainesville (USA). Dept. of Physics). 1984. Contract AS05-81ER40008. 35p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85001329.

Theoretical Physics Preprint Series UFTP-84-4.

We relate some mathematical results concerning the Virasoro algebra to properties of dual models. Specifically, we show how to compute the Kac determinant using well-known techniques from dual models. Then we use the Kac formula to discuss the validity of No-ghost theorem of dual models in a more general setting than the original proofs of that theorem. 14 references.

48677 (INIS-mf—9032, pp BB11-BB26) **Penetrating the structure of particles.** Blazek, M. (Slovenska Akademia Vied, Bratislava (Czechoslovakia). Fyzikalny Ustav). 1981. (In Slovak). NTIS (US Sales Only), PC A06/MF A01. File Number TI84780517. (CONF-8108164—Pt.2).

From 7. conference of Czechoslovak physicists; Prague, Czechoslovakia (24 Aug 1981).

A survey is presented of the history of the structure of elementary particles. The models discussed include the color model, the quark model and the gluon model. The most significant results are presented which may be obtained on the basis of the arrangement of particles into groups within the SU-5 group. Attention is also devoted to basic interactions between particles and their unification.

48678 **(INIS-mf—9041) Small QCD corrections in inclusive O^{-+} quarkonium decay for the bound state renormalization scheme.** Kummer, W.; Wirthumer, G. (Technische Univ., Vienna (Austria). 1. Inst. fuer Theoretische Physik). Apr 1983. 21p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84780554.

A consistent field theoretic computation of the first order correction to the total decay of a nonrelativistic heavy quarkonium state must consider contributions from the annihilation amplitude, with a typical scale of the order of the quark mass m, and from the bound state wave-function, where the typical scale is of the order of the Bohr-momentum αsub(s)m. Therefore, not only the latter smaller scale is the one to be taken for the total decay rate, but also a quite specific renormalization, the 'bound-state renormalization scheme', must be used for a computation of the total inclusive decay rate of $O^{-+} \rightarrow$ hadrons. Due the important cancellations between large individual contributions, the net result turns out to be small, encouraging the use of pure perturbative QCD in such systems.

48679 **CP nonconservation in the partial decay rates of charm and beauty mesons.** Chau, L.; Cheng, H. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review Letters;* **53**: No. 11, 1037-1040(10 Sep 1984). Contract AC02-76CH00016.

The partial rate differences between particle and antiparticle decaying into their corresponding CP-conjugate states for the charm and beauty mesons F^{+-}, D^{+-}, B/sub u/$^{+-}$, and B/sub c/$^{+-}$ are estimated. Some decays have appreciable partial rate differences, notably B/sub u/$^{-}\rightarrow\pi^{0}K^{-}$,$D^{-}$ D/sup 0asterisk/ and B/sub c/ $^{-}\rightarrow K^{-} D^{0},\pi^{-} D^{0},\pi^{0}D^{-}$. The uncertainties involved in such analysis are discussed.

48680 **Phase shifts of the skyrmion breathing mode.** Breit, J.D.; Nappi, C.R. (The Institute for Advanced Study, Princeton, New Jersey 08540). *Physical Review Letters;* **53**: No. 9, 889-891(27 Aug 1984). Contract AC02-76ER02220.

Phase shifts for the skyrmion breathing mode are calculated and indications of a resonance in this channel are found. We identify this resonance with the N(1440) and Δ(1600).

48681 **Possible supersymmetry scenario for pp-bar collider monojet events and unaccompanied "photon" events.** Barger, V.; Hagiwara, K.; Woodside, J.; Keung, W. (Physics Department, University of Wisconsin, Madison, Wisconsin 53706). *Physical Review Letters;* **53**: No. 7, 641-643(13 Aug 1984). Contract AC02-76ER00881;AC02-76CH00016.

Anomalous missing-p/sub T/ events observed at the CERN pp-bar collider can be plausibly explained by the photino decay mode q→qgamma-tilde of scalar quarks with mass ~100 GeV. This gives a Jacobian peak in the jet p/sub T/ distribution suggested by the data of Arnison et al. Two-photon decays of π^{0}, eta, eta' may account for the "photon" events. To account for the reported rates and to avoid gluino mass limits, the gluino and photino must be light and nearly degenerate.

48682 **Higgs-scalar decays: H→W(+X.** Keung, W.; Marciano, W.J. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] D: Particles and Fields;* **30**: No. 1, 248-250(1 Jul 1984). Contract AC02-76CH00016.

Decays of a Higgs scalar in the mass range m/sub W/< or ≈m/sub H/< or ≈2m/sub W/ (m/sub W/ = W^{+-} mass≈83 GeV) are examined. For m/sub H/> or ≈125 GeV, the branching ratio for $H\rightarrow W^{+-}+X$ is found to be substantial, provided the top quark is heavy, m/sub t/>m/sub H//2. Implications of our results for hadron-hadron-collider experiments are briefly discussed.

48683 **Study of $\pi 0 \to \mu$ (ϵ^{+-}) decays.** Herczeg, P.; Hoffman, C.M. (Theoretical and Medium-Energy Physics Divisions, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *D: Particles and Fields;* **29**: No. 9, 1954-1961(1 May 1984).

We deduce an experimental upper bound $(1/2)[\Gamma(\pi^0 \to \mu^+ e^-) + \Gamma(\pi^0 \to \mu^- e^+)]/ \Gamma(\pi^0 \to \text{all}) < 7 \times 10^{-8}$ (90% C.L.) on the branching ratios of $\pi^0 \to \mu^{+-} e^{-+}$ decays from available data. We consider the existing constraints on the underlying muon-number-violating interaction and find that the present experimental information on $\mu^- \to e^-$ conversion in sulfur implies an upper limit on the $\pi^0 \to \mu^{+-} e^{-+}$ branching ratios which is not likely to be larger than 10^{-15}.

48684 **Can soft gluon effects be measured in electron-positron annihilation.** Kodaira, Jiro; Trentadue, L. (Stanford Linear Accelerator Center, CA). *Progress of Theoretical Physics (Kyoto);* **69**: No. 2, 693-697(Feb 1983).

48685 **Diffractive dissociation and new quarks.** White, A.R. (Argonne National Laboratory, IL (USA)). pp 115-123 of Antiproton proton physics and the W discovery. Proceedings of 3. Moriond workshop. Tran Thanh Van, J. (ed.). Gif-sur-Yvette, France; Editions Frontieres (1983). (CONF-830377—).

From 18. Recontre de Moriond conference. 3. Moriond workshop; La Plagne, France (19 Mar 1983).

We argue that the chiral limit of QCD can be identified with the strong (diffractive dissociation) coupling limit of reggeon field theory. Critical Pomeron scaling at high energy must then be directly related to an infrared fixed-point of massless QCD and so requires a large number of flavors. This gives a direct argument that the emergence of diffraction peak scaling, KNO scaling etc. at antip-p colliders are evidence of a substantial quark structure still to be discovered.

6453 Particle Invariance Principles And Symmetries

REFER ALSO TO CITATION(S) 64530048679, 48717

48686 **(BNL—35082) Thin end of the wedge.** Roy, P. (Brookhaven National Lab., Upton, NY (USA); Tata Inst. of Fundamental Research, Bombay (India)). 1984. Contract AC02-76CH00016. 14p. (CONF-8406190—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84016439.

From Theoretical workshop on electroweak symmetry breaking at the superconducting super collider; Berkeley, CA, USA (4 Jun 1984).

A top mass in the range 20 to 55 GeV imposes tight bounds on the light Higgs masses in the minimal SUSY-extended electroweak theory with soft SUSY-breaking and radiative EW-breaking induced at the same scale by an underlying N=1 SUGRA GUT. In particular, the lightest Higgs must weigh quite a bit less than M/sub Z//2, being therefore detectable at SLC and LEP. This will be a test for such theories.

48687 **Application of a softly broken supersymmetric model to the properties of the scalar neutrino.** Haber, H.E.; Barnett, R.M.; Lackner, K.S. (Department of Physics, University of California, Santa Cruz, California 95064 and Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Physical Review* [*Section*] *D: Particles and Fields;* **29**: No. 9, 1990-2004(1 May 1984). Contract AC03-76SF00515.

We describe a simple, softly broken supersymmetric model of electroweak interactions. In its simplest form, supersymmetry breaking is imposed via explicit mass terms for scalar quarks and leptons. We apply this model to the discussion of the decay properties of the scalar neutrino ν/sub s/. The one-loop process ν/sub s/ $\to \nu +$gamma-tilde (gamma-tilde = photino) is computed as well as multibody (tree-level) decays of the ν/sub s/. The relative branching ratios are crucial for determining the phenomenological signatures of the scalar neutrino. Complications to the model due to Majorana mass terms for the gauge fermions are discussed. Explicit Feynman rules for the model are listed.

6454 Field Theory

REFER ALSO TO CITATION(S) 64540048678, 48680

48688 (CONF-8404119—, pp 12-20) **Lattice guage theories on a hypercube computer.** Otto, S.W. (California Inst. of Tech., Pasadena). Jun 1984. NTIS, PC A15/MF A01. File Number TI84014856.

From Workshop on gauge theory on a lattice; Argonne, IL, USA (5 Apr 1984).

A report on the parallel computer effort underway at Caltech and the use of these machines for lattice gauge theories is given. The computational requirements of the Monte Carlos are, of course, enormous, so high Mflops (Million floating point operations per second) and large memories are required. Various calculations on the machines in regards to their programmability (a non-trivial issue on a parallel computer) and their efficiency in usage of the machine are discussed.

48689 (CONF-8404119—, pp 21-26) **Parallel supercomputers and lattice guage theories.** Terrano, A. (Columbia Univ., New York, NY). Jun 1984. NTIS, PC A15/MF A01. File Number TI84014856.

From Workshop on gauge theory on a lattice; Argonne, IL, USA (5 Apr 1984).

Numerical studies of lattice gauge theories are limited by the power of the computers used for them. A more powerful and cost effective type of computer consisting of an array of single board computer/array processors is proposed. The overall design, subsystems, programming and performance of such a computer are discussed.

48690 (CONF-8404119—, pp 27-42) **Discussion paper for a highly parallel array processor-based machine.** Hagstrom, R.; Bolotin, G.; Dawson, J. (Argonne National Lab., IL). Jun 1984. NTIS, PC A15/MF A01. File Number TI84014856.

From Workshop on gauge theory on a lattice; Argonne, IL, USA (5 Apr 1984).

The architectural plant for a quickly realizable implementation of a highly parallel special-purpose computer system with peak performance in the range of 6 billion floating point operations per second is discussed. The architecture is suitable to Lattice Gauge theoretical computations of fundamental physics interest and may be applicable to a range of other problems which deal with numerically intensive computational problems. The plan is quickly realizable because it employs a maximum of commercially available hardware subsystems and because the architecture is software-transparent to the individual processors, allowing straightforward re-use of whatever commercially available operating-systems and support software that is suitable to run on the commercially-produced processors. A tiny prototype instrument, designed along this architecture has already operated. A few elementary examples of programs which can run efficiently are presented. The large machine which the authors would propose to build would be based upon a highly competent array-processor, the ST-100 Array Processor, and specific design possibilities are discussed. The first step toward realizing this plan practically is to install a single ST-100 to allow algorithm development to proceed while a demonstration unit is built using two of the ST-100 Array Processors.

48691 (CONF-8404119—, pp 43-53) **Microcanonical simulation of lattice QCD with quarks.** Polonyi, J. (Univ. of Illinois, Urbana). Jun 1984. NTIS, PC A15/MF A01. File Number TI84014856.

From Workshop on gauge theory on a lattice; Argonne, IL, USA (5 Apr 1984).

A brief survey of the microcanonical simulation of SU(3) lattice gauge theory running in collaboration with J. Kogut, H.W. Wyld, J. Shigemitsu and D.K. Sinclair is given. The signature of thermally unstable region at the deconfining phase transition in the quenched case and a phase transition in the presence of light quarks are surveyed.

48692 (CONF-8404119—, pp 54-60) **Hadron mass inequalities.** Weingarten, D. (IBM T.J. Watson Research Center, Yorktown Heights, NY). Jun 1984. NTIS, PC A15/MF A01. File Number TI84014856.

From Workshop on gauge theory on a lattice; Argonne, IL, USA (5 Apr 1984).

Rigorous proofs of two inequalities bounding hardon masses from below with the mass of the pion are given. The consequence of these inequalities for chiral-symmetry breaking is considered.

48693 (CONF-8404119—, pp 61-68) **Rigorous results in finite temperature lattic gauge theories.** Tomboulis, E.T. (Univ. of California, Los Angeles). Jun 1984. NTIS, PC A15/MF A01. File Number TI84014856.

From Workshop on gauge theory on a lattice; Argonne, IL, USA (5 Apr 1984).

SU(2) lattice gauge theories in two or more space dimensions with any value of the bare coupling are proven rigorously to possess a non-confining phase at high temperature. For SU(2) lattice gauge theories coupled to massless fermions, the absence of chiral symmetry breaking for sufficiently high temperature or chemical potential is rigorously proven in any dimension.

48694 (CONF-8404119—, pp 69-84) **Topology in the O(3) σ-model in two-dimensions.** Bhanot, G. (Inst. for Advanced Study, Princeton, NJ). Jun 1984. NTIS, PC A15/MF A01. File Number TI84014856.

From Workshop on gauge theory on a lattice; Argonne, IL, USA (5 Apr 1984).

Some recent results regarding various aspects of topology, topological order parameters, vacua and phase transitions driven by topological charge condensation in the lattice O(3) σ-model in two dimensions are discussed.

48695 (CONF-8404119—, pp 85-101) **Lattice calculation of hadronic weak matrix elements: the $\Delta I = 1/2$ rule.** Bernard, C. (Univ. of California, Los Angeles). Jun 1984. NTIS, PC A15/MF A01. File Number TI84014856.

From Workshop on gauge theory on a lattice; Argonne, IL, USA (5 Apr 1984).

A lattice Monte Carlo technique for calculating the matrix elements of weak operators is described. Emphasis is placed on the $\Delta I = 1/2$ rule, which is such a large effect that the significant errors associated with current lattice methods (statistics, finite size, finite lattice spacing, extrapolations in quark mass, etc.) should not disguise the important qualitative features. A detailed exposition of the analytic bases for the calculation is given, and an attempt is made to avoid the questionable phenomenological assumptions (such as some of those inherent in the Penguin approach) which were necessary when matrix elements could not be calculated. The current state of the calculation-in-progress is described. This work is being done in collaboration with A. Soni, T. Draper, G. Hockney, and M. Rushton.

48696 (CONF-8404119—, pp 102-109) **Meson and baryon couplings in lattice QCD.** Gottlieb, S. (Univ. of California, San Diego, La Jolla). Jun 1984. NTIS, PC A15/MF A01. File Number TI84014856. Contract AT03-81ER40029.

From Workshop on gauge theory on a lattice; Argonne, IL, USA (5 Apr 1984).

The external source method for calculating strong hadronic decays is described. This technique requires computer time comparable to that required for spectrum calculations. Results for rho decay and decuplet baryon decays are described for a $6^3 \times 12 \times 18$ lattice at $\beta = 5.7$.

48697 (CONF-8404119—, pp 110-119) **Deconfinement at finite temperature and the continuum limit of lattice quantum chromodynamics.** Pendleton, B.J. (Univ. of California, Santa Barbara). Jun 1984. NTIS, PC A15/MF A01. File Number TI84014856.

From Workshop on gauge theory on a lattice; Argonne, IL, USA (5 Apr 1984).

The results of a Monte Carlo simulation of lattice Quantum Chromodynamics at finite temperature are presented. A qualitative theoretical picture of the deconfining phase transition is developed and used to guide this analysis of the Monte Carlo data. For lattice couplings $g^2 > 1$, the critical temperature shows a clear deviation from asymptotic scaling as given by the perturbative β function. Below $g^2 = 1$, a behaviour consistent with asymptotic scaling is observed. Finite size scaling in used to analyse the dependence of the critical temperature on the spatial volume of the lattice. A brief description of the author's CDC CYBER 205 computer program is also given.

48698 (CONF-8404119—, pp 120-130) **Calculations in lattice QCD with light quarks.** Barbour, I.M. (Univ. of Glasgow, Scotland). Jun 1984. NTIS, PC A15/MF A01. File Number TI84014856.

From Workshop on gauge theory on a lattice; Argonne, IL, USA (5 Apr 1984).

Calculations of quenched QCD on a lattice are described for the chiral condensate and the low lying hadron spectrum. Evndence for scaling is found in both cases.

48699 (CONF-8404119—, pp 131-137) **Heavy quark potential.** Stack, J.D. (Univ. of Illinois, Urbana). Jun 1984. NTIS, PC A15/MF A01. File Number TI84014856. Contract AC03-81ER40050.

From Workshop on gauge theory on a lattice; Argonne, IL, USA (5 Apr 1984).

The results of a recent high statistics calculation of the SU(3) heavy quark potential on a $12 \times 12 \times 12 \times 16$ lattice is described. The validity of scaling is tested quantitatively. New results are given for the string tension and the strength of the long range Coulomb term.

48700 (CONF-8404119—, pp 138-142) **Monte Carlo Renormalization Group study for SU(3) lattice gauge theory.** Hasenfratz, A. (CERN, Geneva, Switzerland). Jun 1984. NTIS, PC A15/MF A01. File Number TI84014856.

From Workshop on gauge theory on a lattice; Argonne, IL, USA (5 Apr 1984).

A special Monte Carlo Renormalization Group method, the so-called ratio method is discussed. Possible systematic error of the method is investigated, and a systematic improvement is proposed based on perturbation theory. The method is applied to determine the β-function of 4 dimensional SU(3) pure gauge theory.

48701 (CONF-8404119—, pp 143-170) **Monte-Carlo Renormalization Group analysis of SU(2) and SU(3) gauge theories.** Gupta, R.; Patel, A. (Northeastern Univ., Boston, MA). Jun 1984. NTIS, PC A15/MF A01. File Number TI84014856. Contract AC03-81ER40050.

From Workshop on gauge theory on a lattice; Argonne, IL, USA (5 Apr 1984).

The results of a Monte-Carlo Renormalization Group calculation of the β -function for the lattice SU(2) and SU(3) gauge theories is presented. It is also shown how the same data can be used to find an improved action for numerical simulations.

48702 (CONF-8404119—, pp 212-217) **Alternate lattices.** Celmaster, W. (Northeastern Univ., Boston, MA). Jun 1984. NTIS, PC A15/MF A01. File Number TI84014856.

From Workshop on gauge theory on a lattice; Argonne, IL, USA (5 Apr 1984).

A brief review is given of the status of gauge theories on nonhypercubic lattices. Some remarks are also made about aspects of computing with these lattices.

48703 (CONF-8404119—, pp 218-229) **Finite-temperature confinement transitions.** Svetitsky, B. (Cornell Univ., Ithaca, NY). Jun 1984. NTIS, PC A15/MF A01. File Number TI84014856.

From Workshop on gauge theory on a lattice; Argonne, IL, USA (5 Apr 1984).

The formalism of lattice gauge theory at finite temperature is introduced. The framework of universality predictions for critical behavior is outlined, and recent analytic work in this direction is reviewed. New Monte Carlo information for the SU(4) theory are represented, and possible results of the inclusion of fermions in the SU(3) theory are listed.

48704 (CONF-8404119—, pp 230-241) **Operator lattices.** Bender, C.M. (Washington Univ., St. Louis, MO). Jun 1984. NTIS, PC A15/MF A01. File Number TI84014856.

From Workshop on gauge theory on a lattice; Argonne, IL, USA (5 Apr 1984).

The finite-element method enables us to convert the operator differential equations of a quantum field theory into operator difference equations. These difference equations are consistent with the requirements of quantum mechanics and they do not exhibit fermion doubling, a problem that frequently plagues lattice treatments of fermions. Guage invariance can also be incorporated into the difference equations. On a finite lattice the operator difference equations can be solved in closed form. For the case of the Schwinger model the anomaly is computed and results in excellent agreement are obtained with the known continuum value.

48705 (CONF-8404119—, pp 242-257) **Variational approach to spectra.** Duncan, A.; Roskies, R. (Univ. of Pittsburgh, PA). Jun 1984. NTIS, PC A15/MF A01. File Number TI84014856.

From Workshop on gauge theory on a lattice; Argonne, IL, USA (5 Apr 1984).

A generalized Lanczos algorithm is applied to the calculation of the mass spectrum in lattice Hamiltonian field theories. Various examples (anharmonic oscillator, the 0(3) σ-model in 1+1D, and Yang Mills in 2+1D and 3+1D) are considered. Detailed results are presented for the 0(3) σ-model, where we obtain agreement is obtained with the extensive Monte Carlo results of Fox et al. The method is entirely analytic in spirit, and hence easily extendable to fermions.

48706 (CONF-8404119—, pp 258-269) **Strings and dimensional reduction in SU(2) lattice gauge theory.** Ambjoern, J.; Olesen, P.; Peterson, C. (NORDITA, Copenhagen, Denmark). Jun 1984. NTIS, PC A15/MF A01. File Number TI84014856.

From Workshop on gauge theory on a lattice; Argonne, IL, USA (5 Apr 1984).

A string theory is compared to SU(2) lattice gauge theory in three dimensions. In three and four dimensions, the hypothesis of dimensional reduction using Monte Carlo data for SU(2) were investigated.

48707 (CONF-8404119—, pp 270-285) **Numerical algorithm to solve loop equations.** Marchesini, G. (Universita di Parma, Italy). Jun 1984. NTIS, PC A15/MF A01. File Number TI84014856.

From Workshop on gauge theory on a lattice; Argonne, IL, USA (5 Apr 1984).

A numerical algorithm for computations in LGT, which solves the loop equations and is defined in the infinite lattice, is described. The algorithm allows the study of the singularities of the theory in the coupling constant g^2 and therefore provides a way to analyze the nature of the phase transitions. Preliminary results are reported for the study of singularities for U(1) gauge theory in D=4 and x-y model in D=2. For the non Abelian case results are reported for U (infinity) gauge model in D=2.

48708 (CONF-8404119—, pp 286-293) **T-expansion and its application to SU(2) lattice gauge theory.** Karliner, M. (Tel Aviv Univ., Ramat-Aviv, Israel). Jun 1984. NTIS, PC A15/MF A01. File Number TI84014856.

From Workshop on gauge theory on a lattice; Argonne, IL, USA (5 Apr 1984).

A scheme allowing systematic improvement of variational calculations has been developed at SLAC. This paper contains an outline of the method, as well as some preliminary results of its application to two dimensional spin systems and four dimensional SU(2) lattice guage theory.

48709 (CONF-8404119—, pp 295-304) **Properties of the Gribov horizon.** Cutkosky, R.E. (Carnegie-Mellon Univ., Pittsburgh, PA). Jun 1984. NTIS, PC A15/MF A01. File Number TI84014856.

From Workshop on gauge theory on a lattice; Argonne, IL, USA (5 Apr 1984).

Three subjects are discussed briefly. The first is the use of the sphere S_3 as a finite-volume box for quantum field theory. Then the QCD Hamiltonian in the Coulomb gauge is reviewed, and some properties of the Fadeev-Popov determinant and the Gribov horizon are discussed. Finally, the results of some numerical calculations on the shape of the horizon and on the mass gap arising through the Gribov confinement scenario are presented.

48710 (CONF-8404119—, pp 305-310) **Frustration and dual superconductivity in lattice gauge theories.** Orland, P. (Imperial Coll., London, England). Jun 1984. NTIS, PC A15/MF A01. File Number TI84014856.

From Workshop on gauge theory on a lattice; Argonne, IL, USA (5 Apr 1984).

Introducing plaquette fields in SU(N) gauge theories yields a mass gap and confinement by a dual Meisnner effect. Sources for the plaquette fields are electric strings. Similiar plaquette fields exist in pure compact lattice gauge theories. In principle they make it possible to expand in h while keeping the guage field compact.

48711 (CONF-8404119—, pp 311-321) **New twists to QCD at large-N.** Klinkhamer, F.R. (Inst. for Theoretical Physics, Santa Barbara, CA). Jun 1984. NTIS, PC A15/MF A01. File Number TI84014856.

From Workshop on gauge theory on a lattice; Argonne, IL, USA (5 Apr 1984).

The recently discovered reduced models of Quantum Chromodynamics in the limit of a large number (N) of colors are discussed, in particular the version that employs appropriate Z(N) twists. Some preliminary numerical data are presented, together with some new analytic results (saddle-points). This may be of some help for understanding the mechanism of confinement, which presumably is the same for all N. Also, the reduced chiral model in two dimensions is discussed.

48712 (CONF-8404119—, pp 325) **Microcanonical simulation of a toy model with vacuum seizing.** Stone, M. (Univ. of Illinois, Urbana). Jun 1984. NTIS, PC A15/MF A01. File Number TI84014856.

From Workshop on gauge theory on a lattice; Argonne, IL, USA (5 Apr 1984).

Tested was a newly developed method for simulating field theories with fermionic degrees of freedom on a simple quantum mechanical model which still has enough structure to exhibit symmetry breaking and other effects due to anomalies.

48713 (CONF-8404119—, pp 326-336) **Monte Carlo simulations with Symanzik improved actions.** Meyer, S. (Universitaet Kaiserslautern, West Germany). Jun 1984. NTIS, PC A15/MF A01. File Number TI84014856.

From Workshop on gauge theory on a lattice; Argonne, IL, USA (5 Apr 1984).

Symanzik's approach to improve the action of a lattice theory perturbatively is discussed. The results of Monte Carlo simulations using improved actions for the two dimensional O(3) model and for SU(2) guage theory are described.

48714 **(INIS-BR—122) Introduction to lattice gauge theories.** Alcaraz, F.C. (Sao Carlos Univ. (Brazil). Dept. de Fisica). 1981. 47p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. File Number DE84780532.

An introduction to lattice gauge theories is made. A gauge theory with Z(2) symmetry (Ising) is studied. A generalization for the Z(N) symmetry case is also made.

48715 **(LA-UR—84-2278) Hydrodynamic flow structures in quantum field theory.** Carruthers, P.; Zachariasen, F. (Los Alamos National Lab., NM (USA)). May 1984. Contract W-7405-ENG-36. 8p. (CONF-8405193—32). NTIS, PC A02/MF A01; GPO Dep. File Number DE84015513.

From Conference on the intersections between particle and nuclear physics; Steamboat Springs, CO, USA (23 May 1984).

The transport of matter is examined in the context of relativistic quantum transport theory for the case of neutral scalar fields. The goal is to formulate a theory valid off mass shell and out of equilibrium. We construct a conserved moment tensor which coincides with the ensemble average of the Noether tensor, or the improved energy-momentum tensor within an additive constant of the improvement term. Conditions for closure of the conservation equation are given for the phi^4 coupling. 8 references.

48716 (SLAC-PUB—3405) Hypermultiplet couplings in N = 2 supergravity. Bagger, J. (Stanford Linear Accelerator Center, CA (USA)). Aug 1984. Contract AC03-76SF00515. 2p. (CONF-840757—9). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84017640.

From 22. international conference on high energy physics; Leipzig, German D.R. (19 Jul 1984).

An arbitrary number of massless spin $(0,\frac{1}{2})$ multiplets are coupled to N = 2 supergravity, and the scalar fields are found to lie on a negatively curved quaternionic manifold. 6 references.

48717 Scalar boson masses in dynamically broken gauge theories. Elias, V.; Scadron, M.D. (Department of Physics, University of Arizona, Tucson, Arizona 85721). *Physical Review Letters;* **53**: No. 12, 1129-1132(17 Sep 1984). Contract AC02-80ER10663.

Assuming that nonperturbative QCD generates the chiral-limiting quark mass and the spinless π and σ mesons, we obtain a gap equation which can be solved for the scalar mass m/sub sigma/ roughly-equal2m/sub qk/ in a manner consistent with the original Nambu—Jona-Lasinio approach. A similar relation is obtained within a hypercolor scenario between the dynamically generated component of the "hyperquark" mass and the mass of the Higgs analog.

48718 Left-right asymmetry from the eight-sphere. Frampton, P.H.; Kephart, T.W. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138). *Physical Review Letters;* **53**: No. 9, 867-870(27 Aug 1984). Contract AS05-79ER10448;AC02-76ER01428.

Compactification of twelve-dimensional space-time with geometry the product of Minkowski space-time with an eight-sphere requires a gauge group which contains Spin(8). This procedure leads to left-right asymmetric gauge couplings to fermions. A model with gauge group Spin(18) has four chiral families.

48719 Finite-temperature phase transitions in SU(3) lattice gauge theory with dynamical, light fermions. Polonyi, J.; Wyld, H.W.; Kogut, J.B.; Shigemitsu, J.; Sinclair, D.K. (Department of Physics, University of Illinois at Urbana-Champaign, 1110 West Green Street, Urbana, Illinois 61801). *Physical Review Letters;* **53**: No. 7, 644-647(13 Aug 1984). Contract AC02-76ER01545;AC02-76ER02978.

SU(3) lattice gauge theory with four light quark species is studied at finite temperature by microcanonical computer simulation techniques. An abrupt transition is found separating the hadronic-matter and the quark-gluon—plasma phases. Measurements of the critical temperature, latent heat, <psi-barpsi>, Wilson line, and Wilson-line correlation function are presented and are compared to earlier calculations which ignored fermion vacuum polarization.

48720 Monte Carlo renormalization group for SU(2) lattice gauge theory. Patel, A.; Cordery, R.; Gupta, R.; Novotny, M.A. (California Institute of Technology, Pasadena, California 91125). *Physical Review Letters;* **53**: No. 6, 527-530(6 Aug 1984). Contract AC03-81ER40050.

We present the results of a Monte Carlo renormalization group calculation using the $\sqrt{3}$ block transformation introduced by Cordery, Gupta, and Novotny. The β function for the SU(2) lattice gauge theory is calculated both along the Wilson axis and along the line K/sub A/ = -0.24K/sub F/ in the fundamental-adjoint plane.

48721 Monte Carlo renormalization-group improved SU(2) lattice action. Gupta, R.; Patel, A. (Physics Department, Northeastern University, Boston, Massachusetts 02115). *Physical Review Letters;* **53**: No. 6, 531-534(6 Aug 1984). Contract AC03-81ER40050.

We describe a method to calculate the renormalized action generated under Monte Carlo renormalization-group transformations. With the use of this method, an approximate renormalized trajectory for the SU(2) lattice gauge theory is mapped over a large range of couplings.

48722 Chern-Simons topological Lagrangians in odd dimensions and their Kaluza-Klein reduction. Wu, Y. (Department of Physics, University of Washington, Seattle, Washington 98195). *Annals of Physics (New York);* **156**: No. 1, 194-211(Aug 1984). Contract AC06-81ER40048.

Clarifying the behavior of generic Chern-Simons secondary invariants under infinitesimal variation and finite gauge transformation, it is proved that they are eligible to be a candidate term in the Lagrangian in odd dimensions (2k-1 for gauge theories and 4k-1 for gravity). The coefficients in front of these terms may be quantized because of topological reasons. As a possible application, the dimensional reduction of such actions in Kaluza-Klein theory is discussed. The difficulty in defining the Chern-Simons action for topologically nontrivial field configurations is pointed out and resolved.

48723 Quantization of the gauge coupling constant in a five-dimensional Yang-Mills-Einstein supergravity theory. Guenaydin, M.; Sierra, G.; Townsend, P.K. (California Institute of Technology, Pasadena, California 91125). *Physical Review Letters;* **53**: No. 4, 322-325(23 Jul 1984). Contract AC03-81ER40050.

We construct the five-dimensional (d = 5) Yang-Mills-Einstein supergravity with noncompact gauge group SU(3,1). This model is a unified theory in the sense that there is a symmetry connecting each field to all the others, and it is the unique d = 5 Yang-Mills-Einstein supergravity theory with this property. We show that consistency of the quantum theory requires the dimensionless product κ^{-1}g/sup s/ of gravitational constant and gauge coupling constant to be quantized.

48724 Quantum field theory in the infinite temperature limit. Jourjine, A.N. (Center for Theoretical Physics, Laboratory for Nuclear Science). *Annals of Physics (New York);* **155**: No. 2, 305-332(Jul 1984). Contract AC02-76ER03069.

The $T = \infty$ limit for renormalizable 4-dimensional Euclidean QFT is considered. A general arguement is presented in three examples: phi^3, QED, QCD. Using an expansion of the Green's functions generating functional, it is shown at $T = \infty$ quantum dynamics generally becomes 3 dimensional. All superficially divergent diagrams survive at $T = \infty$ and ensure renormalization of effective dynamics. The correction to naive dimensional reduction is studied; appearance of "electric" masses in QED and QCD is shown to be the result of such a correction. A curious symmetry of the generating functional in QED and QCD, its implications and breaking by the thermal corrections of heavy modes are discussed. Presence of the symmetry implies survival of some fermion modes at $T = \infty$.

48725 Confinement of non-Abelian monopoles in the MIT bag model. Lizzi, F. (Physics Department, Syracuse University, Syracuse, New York 13210). *Physical Review [Section] D: Particles and Fields;* **29**: No. 12, 2972-2974(15 Jun 1984). Contract AC02-76ER03533.

Using topological arguments it is shown that in the context of the MIT bag model single non-Abelian monopoles are impossible and that the total magnetic flux of the bag must be Abelian. The size of the color-singlet bag containing three monopoles is estimated and found to be of the same order as a hadron bag, which may cause a problem for the conventional discussion of monopole catalysis of baryon decay.

48726 **Comment on "Quantization in the temporal gauge".** Hossein Partovi, M. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Physical Review [Section] D: Particles and Fields;* **29**: No. 12, 2993-2994(15 Jun 1984). Contract AC03-76SF00515.

A contradictory result recently reported for canonical quantization in the temporal gauge, and claimed to render the validity of the quantization procedure itself doubtful, is shown to be incorrect and the result of the application of a nonexistent Hermiticity property with respect to the unphysical degrees of freedom of the gauge field.

48727 **Comment on "Quantization in the temporal gauge".** Hatfield, B.F. (California Institute of Technology, Pasadena, California 91125). *Physical Review [Section] D: Particles and Fields;* **29**: No. 12, 2995-2996(15 Jun 1984). Contract AC03-81ER40050.

It is pointed out here that an inconsistency between the commutation relations and the implementation of Gauss's law as a constraint in the temporal gauge for QED involves only the longitudinal part of the vector potential. Therefore, it will not affect the physically interesting results. The electric and magnetic field commutators derived from the temporal-gauge commutators are gauge invariant, and consistent with Gauss's law. In addition, the ground state of the free electromagnetic field is well known and is an eigenstate of the Hamiltonian. No suggestion is made to remedy the inconsistency in the temporal gauge.

65 PHYSICS. II.

6510 Nuclear Physics

48728 **(BNL-NCS—51572-Add.) Compilation of requests for nuclear data. Addendum.** (Brookhaven National Lab., Upton, NY (USA)). Sep 1984. Contract AC02-76CH00016. 12p. (DOE/NDC—28/U-Add.). NTIS, PC A02/MF A01; GPO Dep. File Number DE85002134.

Each request is assigned a unique identifying number. The first two digits of this number give the year the request was initiated. All requests for a given Isotope and Quantity are grouped (or blocked) together. The requests in a block are followed by any status comments. Each request has a unique Isotope, Quantity and Requester. The requester is identified by laboratory, last name, and sponsoring US government agency, e.g., BET, Steen, DNR. All requests must give the energy (or range of energy) for the incident particle when appropriate. The accuracy needed in percent is also given. The error quoted is assumed to be 1-σ at each measured point in the energy range requested unless a comment specifies otherwise. Sometimes a range of accuracy indicated by two values is given or some statement is given in the free text comments. An incident energy resolution in percent is sometimes given.

48729 **(DOE/ER/05034—7) Experimental nuclear physics at Vanderbilt University. Progress report, August, 1983-August, 1984.** Hamilton, J.H. (Vanderbilt Univ., Nashville, TN (USA). Dept. of Physics and Astronomy). 1984. Contract AS05-76ER05034. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85001340.

Progress summaries are given in the fields of in-beam gamma ray spectroscopy, nuclei far from stability, nuclear reaction mechanism studies, delta-electron spectroscopy, theoretical studies, and other research and activities. Status of the Joint Institute for Heavy Ion Research is reviewed. (WHK)

48730 **(DOE/ER/10565—9) Progress report for cyclotron based nuclear science.** Youngblood, D.H. (Texas A and M Univ., College Station (USA). Cyclotron Inst.). Sep 1984. Contract AS05-78ER06036;AS05-80ER10565. 123p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85001609.

Research activities and progress on construction of the new cyclotron facility are summarized. Research is described under the headings heavy-ion reactions, nuclear structure, nuclear theory, and atomic studies. Progress in instrumentation and systems development is discussed. Publications are listed. (WHK)

6511 Experimental Techniques

REFER ALSO TO CITATION(S) 65110048379

48731 **(CEA-CONF—7111) Nuclear physics with antiprotons.** Garreta, D. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Nov 1983. 11p. (CONF-8310269—5). NTIS (US Sales Only), PC A02/MF A01. File Number DE84751747.

From French-Japanese colloquium on comparison between hadronic and nuclear research at intermediate energies; Dogashima, Japan (3 Oct 1983).

The use of antiproton beams in Nuclear Physics has been until now limited to a few total and reaction cross section measurements and to the study of antiprotonic atoms. This situation is presently about to change with the advent of the low Energy Antiproton Ring "LEAR" at CERN which started to deliver antiprotons for Physics experiments in July 1983. But what can we learn from Nuclear Physics with antiprotons. To answer this question I will first review basic and simple features of the low energy antiN-N interaction and their energy dependence. I will show that the antiproton is an interesting probe to explore the nucleus and bring informations complementary to that already provided by the other usual probe like e, p, π, α particles etc... I will in turn point out a few points that make a nucleus a very useful laboratory to study the antiN-N elementary interaction and get informations that are not available in the free antiN-N interaction.

48732 **(CEA-CONF—7122) Physics program for a 2 GeV, 100% duty factor electron accelerator.** Laget, J.M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Nov 1983. 10p. (CONF-8310269—4). NTIS (US Sales Only), PC A02/MF A01. File Number DE84751746.

From French-Japanese colloquium on comparison between hadronic and nuclear research at intermediate energies; Dogashima, Japan (3 Oct 1983).

Electron beams are a powerful tool. In electron scattering the possibility of varying independently the energy transfer, the momentum transfer and the polarization of the virtual photon makes it possible to study systematically the different parts of the nuclear dynamics. The use of real or virtual photon beams is a very efficient way to look for very excited states and to study their form factors and their shapes. It is also possible to reach very high momentum transfers and to get rid of the multiple scattering of the probe (which always occurs for hadronic projectiles). This is the best way to study mechanisms which occur at short distances, and which lead to strongly correlated particles in the final state. But the corresponding experiments are also difficult, since they require the detection of several particles in coincidence, and correspond to small transition rates. An energy of 2 GeV and a duty factor close to 100% allow to achieve this goal. The high duty factor makes it possible to perform easily the coincidence experiment: they are the only way to disentangle the various reaction channels, and to single out the mechanisms which are sensitive to short range effects. The energy is high enough to make possible the separation between the longitudinal and the transverse part of the cross section, and to study the spatial behavior of the nuclear transitions at distance as small as .2 fm over the energy range where the Δ-resonance is created. This is the transition domain between two extreme pictures of the nuclear matter.

48733 **(DOE/ER—0201) Report of the 1983 NSAC Instrumentation Subcommittee.** (USDOE Office of Energy Research, Washington, DC. Nuclear Physics Div.; National Science Foundation, Washington, DC (USA). Div. of Physics). May 1984. 58p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85001916.

This report deals with the present state and future opportunities in instrumentation available to nuclear scientists in the United States to further probe the nature of nuclear matter. The report was written by a group convened by DOE/NSF as a subcommittee of the Nuclear Science Advisory Committee (NSAC). Findings and recommendations of the subcommittee are detailed. (WHK)

6512 Nuclear Properties And Reactions, A=1-5

48734 **(DOE/ER/13065—396) Consistency between electron, muon and neutrino experiments on nuclear targets.** Bodek, A. (Rochester Univ., NY (USA). Dept. of Physics and Astronomy). 1984. Contract AC02-76ER13065. 2p. (CONF-840757—10). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85002074.

From 22. international conference on high energy physics; Leipzig, German D.R. (19 Jul 1984).

The ratio of the differential cross sections are shown for the scattering from iron (Fe) and from deuterium (D) for electron scattering data, muon scattering data from the EMC and BCDMS groups, and older muon scattering data from the Fermilab CCM magnet facility. Reasons for there is general agreement among the experiments about the trend at large Bjorken X, but there is disagreement at low X. Reasons for the low X difference are discussed. (WHK)

48735 **(TRI-PP—84-31) Test of charge symmetry in n-p elastic scattering at 480** MeV. Abegg, R.; Birchall, J.; Cairns, E.; Coombes, H.; Davis, C.A.; Davison, N.E.; Delheij, P.; Green, P.W.; Greeniaus, L.G.; Gubler, H.P. (Alberta Univ., Edmonton (Canada). Dept. of Physics; Manitoba Univ., Winnipeg (Canada). Dept. of Physics; Basel Univ. (Switzerland). Inst. fuer Physik; British Columbia Univ., Vancouver (Canada). TRIUMF Facility). May 1984. 4p. (CONF-8405193—42). NTIS (US Sales Only), PC A02/MF A01. File Number DE84901559.

From Conference on the intersections between particle and nuclear physics; Steamboat Springs, CO, USA (23 May 1984).

An experiment to investigate the isospin-mixing charge-symmetry breaking component in the n-p interaction is under way at TRIUMF. The experiment measures the difference ΔA between the neutron and proton analyzing powers A/sub n/ and A/sub p/ in n-p elastic scattering at 480 MeV. The experiment consists of two interleaved phases in which polarized (unpolarized) neutrons are scattered from an unpolarized (polarized) proton target of the frozen spin type. As a null measurement, requiring no accurately known polarization standards, the experiment determines the difference in angle at which A/sub n/ and A/sub p/ cross through zero. It intends to provide an unambiguous test of class IV charge-symmetry breaking effects to the level of $\Delta A \simeq 0.001$, corresponding to a laboratory angle difference at zero crossing of ~ 0.04°.

48736 **Deuteron forward photodisintegration.** Friar, J.L.; Gibson, B.F.; Payne, G.L. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] C: Nuclear Physics;* 30: No. 2, 441-455(Aug 1984).

The deuteron photodisintegration with forwardgoing proton is calculated using a new formalism for organizing matrix elements. Relativistic effects are thoroughly discussed. Different ways of calculating retarded electric multipoles are investigated. Meson exchange currents are included in various approximations. The spin-orbit dipole operator is found to dominate the relativistic corrections.

6513 Nuclear Properties And Reactions, A=6-19

48737 **(DOE/ER/05126—232) Momentum space approach to microscopic effects in elastic proton scattering.** Picklesimer, A.; Tandy, P.C.; Thaler, R.M.; Wolfe, D.H. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Jun 1984. Contract AS05-76ER05126. 66p. (ORO—5126-232). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85001613.

The microscopic non-relativistic first-order optical potential for proton-nucleus scattering is studied in some detail. Momentum-space calculations have been performed for a number of different target nucli at proton energies above ~100 MeV and these microscopic predictions are compared with experimental cross section, analyzing power, and spin-rotation function data. The input to these calculations consists of the free on-shell nucleon-nucleon t-matrix, its non-local and off-shell structure, the treatment of the full-folding integral, and target densities obtained from electron scattering. Off-shell and non-local effects, as well as various factorization approximations, are studied. The sensitivity to uncertainies in the off-shell extension of the t-matrix, within the context of the Love-Franey model, is explicitly displayed. Similarly, uncertainties due to non-localities and incomplete knowledge of nuclear densities are shown. Explicit calculations using the t-matrix of Love and Franey indicate that these effects play significant roles only for relatively large angles ($\Theta \leqq 60^{\circ}$) and/or lower energies (~150 MeV). These studies reinforce the conclusion that the lack of agreement between such first-order predictions and the data for spin observable at small angles arises from a physical effect not included in the non-relativistic first-order theory, rather than from any uncertainty in the calculation or in its input. 31 references.

48738 **Thermal response of light nuclei with a realistic effective Hamiltonian.** Bozzolo, G.; Vary, J.P. (Physics Department, Iowa State University, Ames, Iowa 50011). *Physical Review Letters;* **53**: No. 9, 903-906(27 Aug 1984). Contract AC02-82ER40068.

A realistic microscopic effective Hamiltonian (H/sub eff/) is employed with the spherical finite-temperature Hartree-Fock approximation to evaluate the thermodynamic properties of ^{16}O and ^{40}Ca. We scale H/sub eff/ to accommodate the A-dependent effects. We then adjust the Hamiltonian slightly to reproduce appropriate ground-state properties in the Hartree-Fock approximation. We find the thermal response of these nuclei to be substantially greater than that obtained with zero-range phenomenological forces.

48739 **Unexpected backward-angle enhancement in ^{19}F+ ^{12}C scattering.** Maguire, C.F.; Bomar, G.L.; Cleeman, L.; Hamilton, J.H.; Piercey, R.B.; Peng, J.C.; Stein, N.; Bond, P.D. (Department of Physics and Astronomy, Vanderbilt University, Nashville, Tennessee 37235). *Physical Review Letters;* **53**: No. 6, 548-551(6 Aug 1984). Contract AS05-76ER05034.

Backward-angle excitation functions have been measured for the ^{12}C+ ^{19}F elastic and inelastic scattering between E/sub c.m./ = 7.4 and 24.4 MeV. Three prominent gross structures (18.0, 20.7, and 22.1 MeV) are observed. The corresponding back-angle elastic angular distributions can each be fitted by a P/sub L/,$0^2(\cos\theta)$ function whose L value tracks about one unit above l/sub grazing/.

48740 **Nuclear shapes and shape transitions.** Bengtsson, R.; Moeller, P.; Nix, J.R.; Zhang, J. (Lund Univ., Sweden). *Physica Scripta;* **29**: No. 5, 402-430(May 1984).

The authors study potential-energy surfaces, ground-state masses and shapes calculated by use of the Yukawa-plus-exponential macroscopic model and a folded-Yukawa single-particle potential for 4023 nuclei ranging from ^{16}O to ^{279}112. An overview of the results is presented in the form of four colour contour diagrams vs. proton number Z and neutron number N. The four diagrams show calculated values of mod(epsilonsub(2)) and epsilonsub(4) at the ground state, microscopic shell-plus-pairing corrections and the deviations between experimental and calculated masses. The diagrams vividly display the regions of magic and deformed nuclei. In particular, the plot of mod(epsilonsub(2)) vs. Z and N clearly shows the well-known deformed actinide and rare-earth regions and the two new deformed regions around A = 80 and A = 100. The plots indicate differences between the various deformed regions. For instance, there are differences in the magnitude of the deformation and in the character of the transition from spherical to deformed shapes. The authors discuss extensively the transition from spherical to deformed shapes and study the relation between shape changes and the mass corresponding to the ground-state minimum, and the significance of additional minima in the nuclear potential-energy surface. The calculated values for the ground-state mass and shape show good agreement with experimental data throughout the periodic system, but some discrepancies remain that deserve further study.

6514 Nuclear Properties And Reactions, A=20-38

REFER ALSO TO CITATION(S) 65141048740, 48751

48741 (CONF-840945—3) **Optical models from low-energy s-, p- and d-wave cross sections.** Johnson, C.H. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84017592.

From Topical conference on neutron-nucleus collisions--a probe of nuclear structure; Glouster, OH, USA (5 Sep 1984).

From transmission measurements with good resolution at low energies one can obtain data on the optical model potential (OMP) for individual partical waves by first making a multilevel analysis to isolate the partial waves and then averaging for comparison to the OMP. For each $J\pi$ the averaging yields two quantities which are related to the amplitude and phase of the OMP scattering function or, alternatively, to the volume integrals of the real and imaginary potentials. Historically, the experimental average have been represented by the s- and p-wave strength functions, S_0 and S_1, and the s-wave scattering radius R′. To make full use of data from modern time-of-flight facilities such as ORELA it is necessary to re-examine the averaging procedure in order to extend it upward both in energy and neutron l-value. This averaging is discussed and applied to data on ^{30}Si, ^{32}S, ^{34}S, ^{40}Ca, ^{60}Ni, ^{86}Kr and ^{208}Pb. The resulting OMP shows a systematic real potential with some indication of a parity dependence. The imaginary potential shows considerable fluctuations indicating the importance of nuclear structure at neutron eneries below 1 MeV. A coupled channel OMP is also discussed for some of the nulei. 19 references.

48742 (CONF-840945—5) **Neutron, alpha and total widths and spin assignments for resonances in ^{33}S + n from 10 to 400 keV.** Coddens, G.P.; Salah, M.; Harvey, J.A.; Hill, N.W. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84017483.

From Topical conference on neutron-nucleus collisions--a probe of nuclear structure; Glouster, OH, USA (5 Sep 1984).

The S-33 neutron total cross section has been measured from 10 keV to 1 MeV. Resonance parameters (E/sub n/, Γ/sub n/, Γ/sub α/, J/sup π/) have been derived in the region from 10 keV to 400 keV.

48743 (INIS-mf—8796) **Formation of tritium in nuclear reactions with light charged projectiles in the energy range up to 100 MeV.** Merkel, M. (Technische Hochschule Darmstadt (Germany, F.R.). Fachbereich 5 - Physik). 5 Jan 1983. 89p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE84780563.

Excitation functions for the formation of tritium in nuclear reactions were determined for the target materials Al-27, V-51, Nb-93, and Au-197, the projectiles p, d, He-3, a, and Li-6 for projectile energies up to 100 MeV (for protons only up to 45 MeV). The tritium formed in the irradiated thick targets was determined after hot extraction by activity measurement in a gas-filled counting tube. The measurement results obtained by this procedure are tritium depth distributions and thick target yields. From the thick target yields the slope of the cross section was derived as function of the projectile energy. The main properties of the excitation functions are surprisingly large cross section for (X,t...) - reactions of maximally 100 mb, which are extensively independent from the target material and show only a faint projectile dependence. Because of these properties it is relatively easily possible to estimate unknown excitation functions for (x,t...) -reactions accurately to a factor 2. The experimental data were compared with results of calculations according to the exciton model. Thereby the formulation of Machner yielded the best agreement. For the cluster formation probability of the triton in the excited compound nucleus values between 1% and 5% were found for the used projectiles. The energy spectra of the emitted tritons are only insufficiently reproduced by the exciton model.

48744 (INIS-mf—9048, pp 47-64) **Brute-force polarization of ^{23}Na and the ^{23}Na(n,γ)^{24}Na reaction. Chapter IV.** Tielens, T.A.A.; Haas, J.B.M. de (Stichting Reactor Centrum Nederland, Petten). 14 Sep 1983. NTIS (US Sales Only), PC A05/MF A01. File Number TI84780564.

In Nuclear spectroscopy of ^{24}Na and ^{46}Sc by thermal neutron capture.

A Na target has been polarized by brute force to 22% and the γ radiation produced by polarized thermal neutron capture has been investigated. The 2^+ channel spin contribution has been determined model independently and unambiguously for 22 primary transitions. The average 2^+ channel contribution is 5.8(5)%. Spins of final levels are in agreement with previous assignments. For three levels spin restrictions have been made. The energies of positive parity levels are in agreement with a shell model calculation in the complete sd shell.

48745 (INIS-mf—9048) **Nuclear spectroscopy of ^{24}Na and the ^{23}Na(eta, γ)^{24}Na reaction. Chapter IV.** Tielens, T.A.A. (Rijksuniversiteit Utrecht (Netherlands)). 14 Sep 1983. 80p. NTIS (US Sales Only), PC A05/MF A01. File Number DE84780564.

Separate entries were made in the data base for each chapter. (WHK)

48746 **Two-pion correlations in heavy ion collisions.** Zaje, W.A.; Bistirlich, J.A.; Bossingham, R.R.; Bowman, H.R.; Clawson, C.W.; Crowe, K.M.; Frankel, K.A.; Ingersoll, J.G.; Kurck, J.M.; Martoff, C.J. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review* [*Section*] *C: Nuclear Physics;* **29**: No. 6, 2173-2187(Jun 1984). Contract AC03-76SF00098.

An application of intensity interferometry to relativistic heavy ion collisions is reported. The correlation between two like-charged pions is used to study the reactions $\mathrm{Ar}+\mathrm{KCl}\rightarrow 2\pi^{+-}+\mathrm{X}$ and $\mathrm{Ne}+\mathrm{NaF}\rightarrow 2\pi^{-}+\mathrm{X}$, both at an incident beam energy of 1.8A GeV. Source sizes and lifetimes are measured and compared to the predictions of simple geometric models and of Monte Carlo cascade calculations. There appears to be a substantial coherent component of the pion source, although measurement is complicated by the presence of final state interactions. A detailed discussion of the techniques of intensity interferometry is also presented. The generation of uncorrelated background events is discussed, along with the influence of the correlation on the background and the prescription for its removal. The statistical errors in the background spectrum are examined and found to have nontrivial implications for the analysis. The effect of the mutual Coulomb repulsion of the two pions, and of the pion-nuclear Coulomb interaction, on the two-pion correlation function is analyzed. The impact parameter bias resulting from a two-pion trigger is calculated and found to be substantial. Finally, a simple model for the interpretation of Gaussian source parameters is presented and compared to the predictions of Monte Carlo cascade calculations.

6515 Nuclear Properties And Reactions, A=39-58

48747 (CONF-840906—2) **Neutron capture and total cross sections for ^{48}Ca: astrophysical implications.** Carlton, R.F.; Harvey, J.A.; Hill, N.W.; Macklin, R.L. (Middle Tennessee State Univ., Murfreesboro (USA); Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400;AS05-80ER10710. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85001759.

From Capture gamma-ray spectroscopy conference; Knoxville, TN, USA (10 Sep 1984).

Attempts to understand abundance anomalies of the Ca isotopes in the Allende meteorite via the nβ-process require 30-keV Maxwellian averaged capture cross sections. Experimental data on ^{48}Ca in this energy region of astrophysical significance is important since a single resonance in this vicinity could dominate the capture cross section. Neutron capture and total cross section measurements have been performed at ORELA on a 9.97-g sample of $CaCO_3$, enriched to 96% ^{48}Ca, over the energy ranges 10 eV to 500 keV (σ/sub γ/) and 10 keV to 4MeV (σ/sub T/). Only two small resonances were found for ^{48} Ca in the 30-keV energy region (at 19.3

and 106.9 keV) and those only in capture. Their contribution to the 30-keV-averaged cross section is only 50 μb compared to 1.0 mb calculated from direct capture. The p-wave strength and large d/sub 5/2/ strength observed above 150 keV do not contribute significantly to the 30 keV capture.

48748 **(CONF-840945—4) d/sub 5/2/-single particle strength in ^{48}Ca + n.** Harvey, J.A.; Johnson, C.H.; Carlton, R.F.; Castel, B. (Oak Ridge National Lab., TN (USA); Middle Tennessee State Univ., Murfreesboro (USA); Queen's Univ., Kingston, Ontario (Canada)). 1984. Contract AC05-84OR21400. 3p. NTIS, PC A03/MF A01; GPO Dep. File Number DE84017591.

From Topical conference on neutron-nucleus collisions--a probe of nuclear structure; Glouster, OH, USA (5 Sep 1984).

The neutron total cross section of ^{48}Ca was measured up to 4 MeV and the data analyzed using an R-matrix code to obtain resonance parameters and potential scattering phase shifts. No s-wave resonances were observed and the small cross sections (~ 0.5 b) at low energy requires a real well depth of 48 MeV. Three strong d-wave resonances (amounting to 45% of the single particle limit) were found in the 0.8 to 2.0 MeV energy region. Shell-model-in-the-continuum calculations agree with these observations.

48749 **Determination of a time scale for the emission of high-energy photons in heavy-ion fusion reactions.** Lazzarini, A.; Habs, D.; Hennerici, W.; Kroth, R.; Schirmer, J.; Metag, V. (Max Planck Institut fuer Kernphysik, D-6900 Heidelberg, West Germany). *Physical Review Letters;* **53**: No. 11, 1045-1048(10 Sep 1984).

Charged-particle—γ-ray coincidences have been measured following the fusion of ^{16}O+ ^{58}Ni at E/sub c.m./ = 60 MeV. Particle energy and angular distributions in coincidence with γ rays detected with the Max Planck Institut—Gesellschaft fuer Schwerionenforschung 4π γ-ray spectrometer are measured, from which it is possible to estimate the time at which high-energy photons are emitted in the compound-nuclear decay process. In addition, information is obtained about the γ-ray multiplicity associated with the energetic photons.

48750 **Freezeout density in relativistic nuclear collisions measured by proton-proton correlations.** Gustafsson, H.A. Gutbrod, H.H.; Kolb, B.; Loehner, H.; Ludewigt, B.; Poskanzer, A.M.; Renner, T.; Riedesel, H.; Ritter, H.G.; Warwick, A. . (Gesselschaft fuer Schwerionenforschung, D-6100 Darmstadt, West Germany and Nuclear Science Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review Letters;* **53**: No. 6, 544-547(6 Aug 1984). Contract AC03-76SF00098.

Proton-proton correlations were measured with the "Plastic Ball" detector for two systems, Ca + Ca and Nb + Nb, at 400 MeV/nucleon as a function of proton multiplicity. The source-size radii extracted from these measurements were found to have a cube-root dependence on the proton multiplicity of the event. The deduced freezeout density, the density at which collisions between fragments cease, was found to be about 25% of normal nuclear matter density.

48751 **Gamow-Teller strength functions with the Lanczos algorithm.** Bloom, S.D. (Lawrence Livermore National Lab., CA (USA)). *Progress in Particle and Nuclear Physics;* **11**: 505-528(1984). (CONF-8304191—).

From International school of nuclear physics; Erice, Italy (6 Apr 1983).

A review of calculations of GT (Gamow-Teller) strength functions using the Lanczos algorithm is presented for the nuclei ^{26}Mg, ^{54}Fe, ^{56}Fe, ^{58}Ni, ^{60}Ni, and ^{90}Zr. A comparison with experimental results is made. The agreement between the experimental and theoretical shapes ranges from good to excellent but the theoretical total strengths are too large by a factor of .45 to .55, the so-called GT quenching factor. The introduction of a limited set of 2p/2h parent-state correlations for Zr did not materially change this finding. However, only a central force was used in all calculations presented here (except for ^{26}Mg) and it is possible that a tensor force in combination with more extended 2p/2h parent state correlations would lead to a highly dispersed GT strength for excitation in the region 15 MeV to 60 MeV or even higher, in consonance with the predictions of previous workers.

6516 Nuclear Properties And Reactions, A=59-89

REFER ALSO TO CITATION(S) 65161048740, 48751

48752 **(CONF-840945—6) Optical model scattering functions for low energy neutrons on ^{86}Kr.** Carlton, R.F.; Harvey, J.A.; Johnson, C.H. (Middle Tennessee State Univ., Murfreesboro (USA); Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400;AS05-80ER10710. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84017482.

From Topical conference on neutron-nucleus collisions--a probe of nuclear structure; Glouster, OH, USA (5 Sep 1984).

Optical scattering functions are deduced from an R-matrix analysis and subsequent averaging of high resolution ^{86}Kr + n transmission data. These functions have been fitted by adjusting the well depths in an optical model with r_0 = r/sub D/ = 1.21 fm, a_0 = 0.66 fm and a/sub D/ = 0.48 fm. The well depths are V_0 = 51.5 MeV and V/sub so/ = 5.5 MeV for l = 1 and V_0 = 48.5 MeV for l = 0. W/sub D/ is about 3.5 MeV for s/sub 1/2/, p/sub 1/2/ and p/sub 3/2/. Each well depth has an uncertainty of about +-1 MeV.

48753 **^{81}Kr-^{81}Br ground-state mass difference and implications for calibration of a ^{81}Br solar neutrino detector.** Burks, B.L.; Anderson, R.E.; Aoki, Y.; Karp, B.C.; Ludwig, E.J.; Thompson, W.J.; Varner, R.L. (Department of Physics and Astronomy, University of North Carolina, Chapel Hill, North Carolina 27514 and Triangle Universities, Nuclear Laboratory, Durham, North Carolina 27706). *Physical Review* [*Section*] *C: Nuclear Physics;* **30**: No. 2, 742-745(Aug 1984). Contract AS05-76ER02408.

The ground-state mass difference between ^{81}Kr and ^{81}Br was determined by a Q-value comparison of the ^{84}Kr(d,t)^{81}Kr and ^{82}Kr(d,^{3}He)^{81}Br reactions. Energy resolution was optimized by using an ion-implanted target. Implications for calibrations of the proposed bromine solar neutrino detector are presented.

6517 Nuclear Properties And Reactions, A=90-149

48754 **(BNL—35167) Intruder states in the cadmium isotopes and a simple schematic calculation.** Aprahamian, A.; Brenner, D.S.; Casten, R.F.; Heyde, K. (Clark Univ., Worcester, MA (USA); Brookhaven National Lab., Upton, NY (USA); Ghent Rijksuniversiteit (Belgium). Lab. voor Kernfysica). 1984. Contract AC02-76CH00016. 6p. (CONF-8405231—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85001353.

From International workshop on interacting boson-boson and boson-fermion systems; Gull Lake, MI, USA (28 May 1984).

Angular correlation studies of ^{118} ^{120}Cd at TRISTAN have allowed the discovery and identification in each nucleus of two new 0^+ states and their respective E2 decay properties. The results have been interpreted in terms of a simple schematic model based on the mixing of normal vibration-like and intruder rotation-like 2p-4h configurations.

48755 **(DOE/ER/10493—15) Atomic mass measurements and nuclear spectroscopy at TRISTAN and nuclidic mass measurements at LAMPF. Progress report, February 1, 1983-September 30, 1984.** Brenner, D.S. (Clark Univ., Worcester, MA (USA)). Sep 1984. Contract AC02-79ER10493. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85000349.

The Clark University research program is concerned with the measurement of atomic masses and understanding the nuclear structures of isotopes far from the line of β stability. This work is accomplished, primarily, by use of the TRISTAN on-line mass separator located at the High Flux Beam Reactor, Brookhaven National Laboratory, where investigations of short-lived fission products have been actively pursued for the past four years. In 1985 mass measurements of light isotopes produced by fragmentation reactions on heavy targets will begin using the TOFI (Time-of-Flight Isochronous) Spectrometer at the LAMPF accelerator, Los Alamos National Laboratory. Together, the two facilities are capable of providing complementary information, potentially of great value in understanding the sum total effect of all nuclear interactions in a given nucleus, which gives rise to the property known as the mass. The thrust of the spectroscopic studies at TRISTAN has been to develop a data base for neutron-rich, far-from-stability nuclides in order to provide a new testing ground for nuclear models. In particular, we have been active in pursuing microscopic and phenomenological understanding of nuclear structure in regions of shape transition near shell and subshell closures. Recent efforts have been concentrated on investigating the interplay of vibrational and rotation-like intruder state degrees of freedom as manifested, for example, in even Cd isotopes near the Z=50 shell. Such studies provide crucial tests of nuclear wave functions and model Hamiltonians.

48756 **Geometry and dynamics of a zero-temperature fermi-gas model for preequilibrium emission of nucleons with application to ^{16}O+^{93}Nb at E/sub Lab/ = 204 MeV.** Davies, K.T.R.; Remaud, B.; Strayer, M.; Devi, K.R.S.; Raffray, Y. (Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Annals of Physics (New York);* **156**: No. 1, 68-109(Aug 1984). Contract W-7405-ENG-26.

A detailed model for prompt, fast nucleon (preequilibrium) nucleon emission is developed and analyzed. The basic scattering behavior in the early stages of the collision is described by a classical trajectory calculation, with particle emission arising from a zero-temperature, Fermi-gas approximation. The emission of a nucleon which has a velocity component normal to the reaction plane is taken into account in the formalism. The refraction of the nucleon trajectories passing through the mean field is studied and different prescriptions for the absorption of nucleons are carefully investigated. The method is applied to the reaction ^{16}O+^{93}Nb at E/sub Lab/ = 204 MeV, and various comparisons are made with particle emission occurring in a recent TDHF study. The calculated multiplicity is greatest for head-on collisions. In addition, inclusive and in-plane energy spectra and angular distributions are presented. The emission of forward-moving nucleons from the projectile (which pass through the target) takes place predominantly in the reaction plane and the angular distribution is strongly peaked, approximately in the forward direction, with the energy spectrum centered about the beam energy per nucleon.

48757 **Interaction between neutron particle-hole and octupole core-coupled states in N=83 nuclei.** Meyer, R.A.; Isacker, P. van; Waroquier, M.; Moreau, J.; Heyde, K.; Wood, J.L. (Kernforschungsanlage Juelich G.m.b.H., Germany, F.R.). *Physics Letters,* [*Section*] *B;* **140**: No. 3/4, 159-162(7 Jun 1984).

We have studied both experimentally and theoretically the interplay between the particle octupole core-coupled states (Jsup(π)=1/2$^+$, ..., 13/2$^+$) and the low-lying neutron 2p-1h intruder excitations with the neutron hole moving in the ssub(1/2)$^{-1}$, 2dsub(3/2)$^{-1}$, and 1hsub(11/2)$^{-1}$ orbitals in odd-mass N=83 nuclei.

48758 **14.6-MeV neutron elastic scattering over a wide mass range.** Hansen, L.F.; Dietrich, F.S.; Pohl, B.A.; Poppe, C.H.; Wong, C. (Lawrence Livermore National Laboratory, P.O. Box 808, Livermore, CA 94550). *Transactions of the American Nuclear Society;* **46**: 627-628(Jun 1984). (CONF-840614—).

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

6518 Nuclear Properties And Reactions, A=150-189

REFER ALSO TO CITATION(S) 65181048766

48759 **(BNL—35154) ARC study of ^{185}W and a test of supersymmetry in the deformed region.** Bruce, A.M.; Warner, D.D. (Brookhaven National Lab., Upton, NY (USA); Manchester Univ. (UK). Schuster Lab.). 1984. Contract AC02-76CH00016. 6p. (CONF-8405231—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE85001352.

From International workshop on interacting boson-boson and boson-fermion systems; Gull Lake, MI, USA (28 May 1984).

An ARC (Average Resonance Capture) study of ^{185}W has been performed in order to identify the complete set of 1/2$^-$, 3/2$^-$ levels below 1.5 MeV. The results have been compared to the Nilsson model and also to the SU(3) limit of the U(6/12) boson-fermion symmetry. Consideration of the level scheme of ^{184}W tests the evidence for supersymmetry in the tungsten nuclei.

48760 **(DOE/ER/02696—25) Neutron cross section measurements using the ORELA: ^{86}Kr(n,x), ^{40}Ca(n,x), ^{22}Ne(n,γ), ^{189}Os(n,n'), $^{186\ 187\ 188\ 189}$Os(n,x), ^{189}Os(n,γ), $^{148\ 149\ 150}$Sm(n,γ), ^{179}Ta(n,γ), $^{86\ 87\ 88}$Sr(n,x), ^{40}Ar(n,x), the stable tellurium isotopes (n,γ) and ^{205}Tl(n,x). Progress report, September 1, 1983-August 31, 1984.** Winters, R.R. (Denison Univ., Granville, OH (USA)). Sep 1984. Contract AC02-76ER02696. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85002059.

The research performed during this reporting period has resulted in (1) publication of two papers dealing with the optical model and with ^{187}Os(n,n') for astrophysics; (2) preparation and submission of two papers describing measurements of $^{148\ 149\ 150}$Sm(n,γ) and ^{60}Ni(n,x) cross sections; (3) mesurement of the ^{189}Os(n,n') cross sections at energies of astrophysical interest; (4) measurement of the ^{189}Os(n,γ) cross sections over a range of energies pertinent to astrophysical interest; (5) extraction of the tantalum target from an ORELA target assembly and arranging shipment of the radioactive tantalum to Kernforschungszentrum, West Germany, in preparation for a measurement of the ^{179}Ta(n,γ) cross sections; and (6) acquistion of a smart terminal computer workstation. Preliminary results from our ^{189}Os measurements are consistent with the cross sections calculated using the same optical model reported by Hershberger et al. for ^{187}Os. Hence the effect of the first excited state in ^{187}Os on the use of the Re/Os beta decay as a stellar nucleosynthesis chronometer is very nearly as estimated by Woosley and Fowler. The duration of galactic nucleosynthesis is now estimated from the Re/Os chronmeter as ~ 11.3 byr. and the age of the universe as ~ 17 byr. 19 references.

6519 Nuclear Properties And Reactions, A=190-219

48761 **(CONF-8403112—6) Photon decay of giant resonances.** Bertrand, F.E.; Beene, J.R.; Halbert, M.L. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85001101.

From International symposium on nuclear spectroscopy and nuclear interactions; Osaka, Japan (21 Mar 1984).

Measurements have been made of the photon decay of the giant multipole resonances in ^{208}Pb. The giant resonances were excited by inelastic scattering of 380 MeV ^{17}O projectile and the photons were detected in the ORNL Spin Spectrometer. The results show a quadrupole resonance ground state gamma branch of 20% while only $\leqq$ 2% of the GQR decay proceeds through the 2.6 MeV, 3$^-$ state. Nearly one half of the GQR decay through a 3$^-$ state at 4.974 MeV. Photon decay from the dipole and monopole resonances and high spin resonances (4+,6+) are also observed.

48762 (CONF-8405231—7) Particle-core coupling calculations for the positive parity states in the odd-mass HG isotopes as a test of IBA core descriptions. Semmes, P.B.; Leander, G.A.; Wood, J.L. (Georgia Inst. of Tech., Atlanta (USA); Oak Ridge Associated Universities, Inc., TN (USA)). 1984. Contract AS05-80ER10599;AS05-76ER03346;AC05-76OR00033. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85001895.

From International workshop on interacting boson-boson and boson-fermion systems; Gull Lake, MI, USA (28 May 1984).

A particle-core coupling calculation has been made for the positive parity states in the odd-mass Hg isotopes, A = 187 to 197. This work employed the results of recent calculations with mixing between different boson numbers to describe the even-mass Hg cores. Comparison between the calculated results and the experimental scheme can be interpreted as a test of the core description. 9 references.

6520 Nuclear Properties And Reactions, A=220 And Above

48763 (INIS-mf—8789) Study of the giant dipole resonance by nuclear resonance fluorescence below the particle threshold. Zurmuehl, U. (Goettingen Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet). 30 Jun 1983. 83p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE84780566.

In this thesis the measurement of the cross sections for nuclear resonance scattering of γ quanta on ^{238}U, ^{181}Ta, ^{165}Ho, ^{139}La, sup(nat)Sb, sup(nat)Tl, ^{209}Bi, and sup(nat)Er is described. From the measured results some information about the structure of these nuclei is obtained.

48764 Concentration of E2 strength near the fission barrier of sup(234,236,238)U. Arruda Neto, J.D.T.; Herdade, S.B.; Nascimento, I.C. do; Berman, B.L. (Sao Paulo Univ., Brazil). *Revista Brasileira de Fisica;* **13**: No. 1, 117-125(Mar 1983).

The electrofission angular distribution for ^{234}U in the energy range 5.5 to 13 MeV were measured and are analyzed together with those obtained previously for ^{236}U and ^{238}U. The competition between the K=0 and K=1 fission channels following E2 excitation is established, showing a dominance of the K=0 channel for near-barrier fission. A substantial concentration of E2 strength near the fission barrier is found, in good agreement with earlier photofission angular-distribution studies.

6530 Nuclear Theory

REFER ALSO TO CITATION(S) 65300048675, 48737

48765 (BNL—35109) Historical perspective of the relation between IBA and VMI at the magic limit: two opposing views. Scharff-Goldhaber, G. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 13p. (CONF-8405231—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84016441.

From International workshop on interacting boson-boson and boson-fermion systems; Gull Lake, MI, USA (28 May 1984).

The two-parameter rotational VMI equations ascribe the observed abrupt change in yrast bands at the magic limit to a first order phase transition. In contrast, two three-parameter anharmonic vibrator models recently suggested yield two limits of validity, neither of which is supported by data. 15 references.

48766 (BNL—35181) U(6/12) symmetry in the deformed region. Warner, D.D. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 17p. (CONF-8405231—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE85001359.

From International workshop on interacting boson-boson and boson-fermion systems; Gull Lake, MI, USA (28 May 1984).

The structure predicted in the SU(3) limit of the U(6/12) boson-fermion symmetry is discussed and compared with the equivalent region of the Nilsson scheme. An unambiguous link between the two frameworks can be established via a study of the single particle structure in each, and this connection points to a physical interpretation for the Casimir operators appearing in the U(6/12) group chain decomposition. The predictions of the symmetry scheme are shown to agree well with the low-lying structure of ^{185}W. Possible future topics of interest stemming from these studies are also discussed. 18 references.

48767 (CONF-8405231—6) Unpaired nucleons as probes of core collective fields. Leander, G.A.; Semmes, P.B.; Doenau, F. (Oak Ridge Associated Universities, Inc., TN (USA); Georgia Inst. of Tech., Atlanta (USA). School of Chemistry; Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). 1984. Contract AC05-76OR00033. 15p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85001864.

From International workshop on interacting boson-boson and boson-fermion systems; Gull Lake, MI, USA (28 May 1984).

Field theory techniques are applied to the study of interacting boson systems. A dynamical quasiparticle theory derived by the equations of motion method is compared with IBFM as a means of coupling an odd particle to IBM cores. For a single j-shell, the two models are found to be roughly equivalent on a phenomenological level. This equivalence requires that the IBFM parameter Λ_0 is a function of the core, SU(5) vs. SU(3) or O(6), but not an explicit function of the Fermi level. IBFM is found to Coriolis attenuate in strong-coupled bands - partly decoupled cases must be investigated further. The dynamical quasiparticle method has advantages with respect to (i) the physical significiance of the pairing Δ as opposed to the IBFM Λjj' 's, (ii) particle transfer at least in principle, and (iii) easy generalizability. In an application of static mean field theory, the α-cluster interpretation of the SU(4) model for the Ra isotopes is tested. It is found that a larger cluster would be required to account for experimental odd-nucleon decoupling factors. 38 references.

48768 (INIS-mf—8806) About the dynamics of statistical fluctuations at fission. Scheuter, F. (Technische Univ. Muenchen, Garching (Germany, F.R.). Fakultaet fuer Physik). 1982. 107p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE84780562.

The dynamics of statistical fluctuations at fission are discussed. Quadratic and non-quadratic potentials are considered and the Fokker-Planck equation is solved for a one-dimensional model. As an example the fission of ^{205}At is discussed.

48769 Interacting boson-fermion model of collective states II. Boson-Fermion symmetries connected with the U(5) limit. Bijker, R.; Kota, V.K.B. (Kernfysisch Versneller Instituut, Rijksuniversiteit Groningen, 9747 AA Groningen, The Netherlands). *Annals of Physics (New York);* **156**: No. 1, 110-141(Aug 1984).

The boson-fermion symmetries, which are connected with the U/sup(B/)(5) limit of the interacting boson model are discussed. These symmetries arise when the bosons have U(5) symmetry and the fermions occupy a single-particle orbit with spin j = 1/2 (Spin(3) limit), j = 3/2 (Spin(5) limit), or j = 3/2, 5/2 (U/sup(B/+F(5) xU/sup(F/)(2) limit). Closed expressions for energy spectra, electromagnetic transition rates, static moments, and (one and two) nucleon transfer reaction intensities are derived.

48770 Temperature dependence of the nuclear response. Civitarese, O.; Broglia, R.A.; Dasso, C.H. (Department of Physics, University of La Plata, c.c. 67, 1900 La Plata, Argentina). *Annals of Physics (New York);* **156**: No. 1, 142-154(Aug 1984). Contract W-7405-ENG-26.

The temperature dependence of the nuclear response function is studied with the random phase approximation. It is found that the strength distributions are rather stable for temperatures up to about 2 MeV. Thermal excitations do affect, however, the low-energy regions of the nuclear spectrum.

48771 **Effect of fluctuations on global analysis of fluid dynamical calculations for high-energy nuclear collisions.** Csernai, L.P.; Fai, G.; Randrup, J. (Hungarian Academy of Sciences, Budapest). *Physics Letters, [Section] B;* **140**: No. 3/4, 149-154(7 Jun 1984).

Composite fragment formation, finite particle number, and statistical fluctuations are shown to have important effects on the global analysis of fluid dynamical results for high-energy nuclear collisions.

48772 **Significance of positive kaon production in low-energy p-nucleus annihilations.** DiGiacomo, N.J.; Clover, M.R. (Los Alamos National Lab., NM). *Journal of Physics G: Nuclear Physics;* **10**: No. 6, L119-L125(Jun 1984).

Positive kaon production resulting from the annihilation of low-energy antiprotons in nuclei is calculated within the intranuclear cascade (INC) model. The results provide a quantitative means of searching for enhanced strangeness production in such interactions.

48773 **Application of the shell model to nuclear spectroscopy.** McGrory, J.B. (Oak Ridge National Lab., Oak Ridge, TN 37830). pp 1-31 of Nuclear structure. Vol. 67. Abrahams, K.; Allaart, K.; Dieperink, A.E.L. New York, NY, USA; Plenum Publishing Corp. (1981). (CONF-8008136—).

From Netherlands Physical Society summer school on nuclear structure; Dronten, Netherlands (13 Aug 1980).

This chapter attempts to present a cursory overview of existing nuclear shell model technology, to give an indication of how well nuclear phenomena can be described by the nuclear shell model, and possible future directions of the field. Examines some truncation methods which might be useful to extend the domain of applicability of the shell model. Discusses approximations to large-space shell model calculations, and the application of neutron-proton clustering in the Fe and Pb regions. Points out that the combination of features that make the nucleus unique are: 1) the microscopic dimensions of the nucleus are such that one must use quantum mechanics; 2) it is a many-body system with 1-300 particles; and 3) of the four "fundamental" interactions (weak, strong, electromagnetic, and gravitational), only the gravitational force is negligible. Concludes that the development of new fields of nuclear science must involve the continued involvement of shell model theory.

48774 **Nuclear structure and heavy-ion reactions.** Schiffer, J.P. (Physics Division, Argonne National Lab., Argonne, IL 60439). pp 127-163 of Nuclear structure. Vol. 67. Abrahams, K.; Allaart, K.; Dieperink, A.E.L. New York, NY, USA; Plenum Publishing Corp. (1981). (CONF-8008136—).

From Netherlands Physical Society summer school on nuclear structure; Dronten, Netherlands (13 Aug 1980).

This chapter reviews the framework in which prominent structures in the excitation functions for some heavy-ion induced reactions are treated in reaction theory, a formalism which was formulated for light particle reactions a third of a century ago. Presents the more subjective criteria of when a structure is "simple" and when it is not. Reviews the experimental data with particular attention to surface-transparent nuclei which seem to show features that may be susceptible to resonance analysis. Examines a case in which such a quantitative analysis has been carried out. Discusses light ion reactions, heavy-ion reactions, Coulomb effects, quasielastic reactions, fusion reactions, resonances in fusion, elastic scattering, and resonances in heavy ion reactions.

6540 Radiation And Shielding Physics

48775 **(CONF-840901—10) Application of the three-dimensional Oak Ridge transport code.** Rhoades, W.A.; Childs, R.L.; Emmett, M.B.; Cramer, S.N. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE84017593.

From ANS topical meeting on reactor physics and shielding; Chicago, IL, USA (17 Sep 1984).

TORT, a 3-d extension of the DOT discrete ordinates transport code is now in production use for studies of radiation penetration into large concrete and masonry structures. This paper discusses certain features of the new code and shows representative results, including comparisons with Monte Carlo calculations.

48776 **(CONF-8404190—1) Stopping powers of solids for low-energy protons.** Ashley, J.C.; Ritchie, R.H. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85001123.

From Warner-Brandt workshop on penetration phenomena: in elastic near-surface interaction; Oak Ridge, TN, USA (12 Apr 1984).

Electron gas models are useful approximations for describing the valence electron response of a solid to the passage of a charged particle. A simple free-electron gas model was used by Fermi and Teller to estimate the time required for a mesotron to be stopped in various solids. More recent work has employed the Lindhard dielectric response function, or approximations thereto, for calculations of the valence electron contributions to energy loss per unit pathlength for protons. Such calculations have generally shown rather poor agreement with experimental data for low-energy protons (velocity small compared to the Fermi velocity, v<<v/sub F/). The purpose of this paper is to draw attention to a recent calculation of the stopping power for slow protons using a density-functional formalism. These new results have been shown to give good agreement with experimental data and thus should provide valuable theoretical guidance in estimating stopping powers of solids for which no experimental data are available.

48777 **(ORNL—4972/R2) MORSE Monte Carlo radiation transport code system.** Emmett, M.B. (Oak Ridge National Lab., TN (USA)). 2 Jul 1984. Contract AC05-84OR21400. 48p. NTIS, PC E03/MF A01; GPO Dep. File Number DE84017312.

Includes 1 sheet of 48x reduction microfiche.

For a number of years the MORSE user community has requested additional help in setting up problems using various options. The sample problems distributed with MORSE did not fully demonstrate the capability of the code. At Oak Ridge National Laboratory the code originators had a complete set of sample problems, but funds for documenting and distributing them were never available. Recently the number of requests for listings of input data and results for running some particular option the user was trying to implement has increased to the point where it is not feasible to handle them on an individual basis. Consequently it was decided to package a set of sample problems which illustrates more adequately how to run MORSE. This write-up may be added to Part III of the MORSE report. These sample problems include a combined neutron-gamma case, a neutron only case, a gamma only case, an adjoint case, a fission case, a time-dependent fission case, the collision density case, an XCHEKR run and a PICTUR run.

48778 **(SAND—84-1789C) Generation of radiation transport geometry from computer-generated design data.** Jones, L.C.; McKeon, D.C. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 13p. (CONF-840901—12). NTIS, PC A02/MF A01; GPO Dep. File Number DE84017380.

From ANS topical meeting on reactor physics and shielding; Chicago, IL, USA (17 Sep 1984).

The Monte Carlo method is the most widely used calculational technique for solving the neutron transport equation in complex, three-dimensional geometries. One of the most time-consuming and error-prone aspects of performing Monte Carlo calculations is the generation of geometry data necessary for describing three-dimensional solid objects. The capability to translate Computer-Aided-Design definition data of solid objects to the geometry description used in Monte Carlo transport codes will significantly reduce the manpower required to perform radiation transport calculations in complex, three-dimensional geometries. Furthermore, the translation process will preserve the original solid model without introducing any human errors into the geometry description. This paper presents work on the translation of a particular type of computer-generated design data to a format suitable for the

MORSE radiation transport code and discusses applications of its use in radiation transport calculations.

48779 (XDC—55-9-150) **Modification of Albert-Welton point attenuation kernel.** Haffner, J.W.; VanValkenburg, H.M. (General Electric Co., Cincinnati, OH (USA). Aircraft Nuclear Propulsion Dept.). 20 Sep 1955. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85001757.

The Albert-Welton point kernel has been modified to allow the use of the more recent oxygen removal cross section of 0.99 barns/atom. The modification did not fundamentally alter any of the physical assumptions in the derivation, and resulted in an improved fit to the BSF centerline data.

48780 **Intensity of secondary scattering of X-rays by noncrystalline materials. Transmission geometry with an incident-beam monochromator.** Dwiggins, C.W. Jr. (Dept. of Energy, Bartlesville, OK). *Journal of Applied Crystallography;* **17**: No. 3, 134-139(1 Jun 1984).

Further information concerning the computer program can be obtained from the author.

Equations are derived for the intensity ratio R of secondary to primary scattering in the fixed-sample transmission case with an incident-beam monochromator crystal that results in a polarization ratio Ksub(m) for unpolarized incident radiation. A table allows R to be calculated for Ksub(m) = 0. This table, along with the one for Ksub(m) = 1 published previously for the case without a monochromator, allows R to be estimated before an experiment is done and thus an optimum experiment can be designed. A simple computer program allows direct calculation of R once experimental data are obtained if it is desired to avoid interpolation. Determination of R involves some approximation, but the values obtained are sufficiently accurate for most purposes. However, R can be improved using exact equations, if desired. If synchrotron radiation polarized normal to the plane of scattering of the monochromator is used, R does not depend on Ksub(m), and the value of R for Ksub(m) = 0 applies despite the true value of Ksub(m). As is expected from symmetry considerations, R is independent of Ksub(m) in the small-angle scattering limit.

48781 **The linear nodal method for shielding applications.** Childs, R.L.; Rhoades, W.A. (Oak Ridge National Laboratory, Oak Ridge, TN 37830). *Transactions of the American Nuclear Society;* **46**: 657-658(Jun 1984). (CONF-840614—).

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

48782 **Monte Carlo computation of differential sensitivity functions.** Watson, C.C. (Schlumberger-Doll Research, P.O. Box 307, Ridgefield, CT 06877). *Transactions of the American Nuclear Society;* **46**: 655-657(Jun 1984). (CONF-840614—).

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

48783 **Analytic representation of fast-neutron total albedos.** Micklich, B.J. (Princeton University, Plasma Physics Laboratory, P.O. Box 451, Princeton, NJ 08544). *Transactions of the American Nuclear Society;* **46**: 628-630(Jun 1984). (CONF-840614—).

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

48784 **A study of scattered fusion neutron distributions in a bounded concrete cell.** Long-poe Ku; Kolibal, J.G. (Princeton University, Plasma Physics Laboratory, P.O. Box 451, Princeton, NJ 08544). *Transactions of the American Nuclear Society;* **46**: 630-631(Jun 1984). (CONF-840614—).

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

6550 Medical Physics

REFER ALSO TO CITATION(S) 65500048532, 48542, 48545, 48558, 48569, 48570

48785 (INIS-BR—121, pp 3-19) **Radiological protection of the patient in the diagnostic X-ray.** Araujo, A.M.C. de (Instituto de Radioprotecao e Dosimetria, Rio de Janeiro (Brazil)). 1983. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. File Number TI84780533. (CONF-8308170—).

From Meeting on medical physics in Rio de Janeiro; Rio de Janeiro, Brazil (25 Aug 1983).

Measures and procedures are given in relation to the radiological protection of the patient in diagnostic radiology. Technical and physical factors of the patient protection are discussed, as radiation beam properties, size of the irradiation field, shieldings, control of the scattered radiation that reaches the imaging record system, films, ecrans and radiographic film processing. General recommendations about the radiation protection of the patient in diagnostic radiology are given.

48786 (INIS-BR—121, pp 20-31) **Occupational radiological protection in diagnostic radiology.** Mota, H.C. (Instituto de Radioprotecao e Dosimetria, Rio de Janeiro (Brazil)). 1983. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. File Number TI84780533. (CONF-8308170—).

From Meeting on medical physics in Rio de Janeiro; Rio de Janeiro, Brazil (25 Aug 1983).

The following topics are discussed: occupational exposure (the ALARA principle, dose-equivalent limit, ICRP justification); radiological protection planning (general aspects, barrier estimation) and determination of the occupational exposures (individual monitoring).

48787 (INIS-BR—121, pp 33-44) **Proposal for the fiscalization of the diagnostic X-ray at state level, based on the experience of Sao Paulo, Sao Paulo State, Brazil.** Craveiro, P.M. (Secretaria de Estado da Saude de Sao Paulo (Brazil)). 1983. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. File Number TI84780533. (CONF-8308170—).

From Meeting on medical physics in Rio de Janeiro; Rio de Janeiro, Brazil (25 Aug 1983).

A special technical guideline is presented for the fiscalization of the radiological protection in installations where ionizing radiations are employed with medical purposes.

48788 (INIS-BR—121, pp 45-53) **External monitoring of area.** Binns, D.A.C. (Instituto de Radioprotecao e Dosimetria, Rio de Janeiro (Brazil)). 1983. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. File Number TI84780533. (CONF-8308170—).

From Meeting on medical physics in Rio de Janeiro; Rio de Janeiro, Brazil (25 Aug 1983).

The practical implications of the ICRP - Publication 26 recommendations about dose limits are dealt with. Monitoring programs are discussed.

48789 (INIS-BR—121, pp 140) **Regulatory guides for radiation protection.** Teixeira, E.E. (Comissao Nacional de Energia Nuclear, Rio de Janeiro (Brazil). Div. de Normas de Protecao). 1983. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. File Number TI84780533. (CONF-8308170—).

From Meeting on medical physics in Rio de Janeiro; Rio de Janeiro, Brazil (25 Aug 1983).

48790 **(INIS-BR—121) Proceedings of the Meeting on Medical Physics in Rio de Janeiro.** (Associacao Brasileira de Fisicos em Medicina, Rio de Janeiro). 1983. 162p. (In Portuguese). (CONF-8308170—). NTIS (US Sales Only), PC A08/MF A01. File Number DE84780533.

From Meeting on medical physics in Rio de Janeiro; Rio de Janeiro, Brazil (25 Aug 1983).

Works carried out on the following subjects are presented: radiological protection in diagnostic X-rays; practical implications of ICRP publication n° 26 in the field of the external monitoring; quality control of medical applications of the ionizing radiations; radiotherapy and radiodiagnosis; dosimetry and radiation protection.

48791 (INIS-BR—121, pp 54-72) **Practical implications of the ICRP - Publication 26 on the neutron external monitoring.** Sordi, G.M.A.A. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). 1983. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. File Number TI84780533. (CONF-8308170—).

From Meeting on medical physics in Rio de Janeiro; Rio de Janeiro, Brazil (25 Aug 1983).

The following topics are dealt with: radiation monitoring (monitoring of the work place, individual monitoring, application of models to the interpretation of the monitoring results, monitoring complementary functions); monitoring of the work place for the external neutronic radiation (a project for a monitoring program, interpretation of the results) and confidence quality.

48792 (INIS-BR—121, pp 73-83) **Practical implications of the ICRP - Publication 26 - Individual external monitoring.** Cunha, P.G. da (Instituto de Radioprotecao e Dosimetria, Rio de Janeiro (Brazil)). 1983. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. File Number TI84780533. (CONF-8308170—).

From Meeting on medical physics in Rio de Janeiro; Rio de Janeiro, Brazil (25 Aug 1983).

The following topics are dealt with: dose limitation system; the Brazilian situation - a proposal in a short time delay, its optimization and implantation in the individual monitoring.

48793 (INIS-BR—121, pp 119) **Dosimetry of two ^{204}Tl beta applicators.** Freitas, Lea C. de (Hospital Santa Rita, Porto Alegre (Brazil)). 1983. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. File Number TI84780533. (CONF-8308170—).

From Meeting on medical physics in Rio de Janeiro; Rio de Janeiro, Brazil (25 Aug 1983).

48794 (INIS-BR—121, pp 128) **Homemade densitometer.** Longo, V.; Foerster, C.E.; Mendonca, A.D.V. 1983. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. File Number TI84780533. (CONF-8308170—).

From Meeting on medical physics in Rio de Janeiro; Rio de Janeiro, Brazil (25 Aug 1983).

48795 **(INIS-mf—8785) Determination of energy absorbed during X-ray exposure of the forearm by means of thermoluminescent dosimetry.** Hofmann, E. (Erlangen-Nuernberg Univ., Erlangen (Germany, F.R.). Medizinische Fakultaet). 15 Mar 1982. 88p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE84780580.

LiF dose meters were used to determine radiation doses in conventional X-ray diagnostic pictures of the forearm. The paper describes a method for determining integral doses by using these dose meters. It describes in detail how a phantom forearm apt for the purpose is to be made. In the Federal Republic of Germany, malignant growth incidence due to X-ray pictures of the forearm is enhanced by about .01 cases each year. The malignant growth incidence rate caused by X-ray diagnostic measures is low. It is therefore generally justified to neglect limbs in exemplary studies of radiation exposure. All calculations and considerations took into account that all possible radiation protection measures have been duly applied.

48796 **(INIS-mf—8853) Method to determine exactly the effective atomic number, electron density and absorbtion coefficient of materials from two computer-tomography measurement.** Christ, G. (Tuebingen Univ. (Germany, F.R.). Fakultaet fuer Physik). 13 Jul 1981. 93p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE84780589.

By the method of computer tomography, which is in use since about 10 years, X-ray images of a layer of interest can be produced without interference from the material present above this layer. An integral measurement of the attenuation of continuous X-radiation is sufficient to record the different attenuation behaviour in a layer for the purpose of image formation. For more information, however, can be obtained by taking into account the spectral distribution of the X-ray source and the energy dependence of the attenuation, which varies for different materials. In the experimental part of this work the measurement of the spectral distribution is described together with the necessary corrections, and the possible application of the cross sections for the relevant interaction processes, which are known from the literature is studied. As shown in the theoretical part, the attenuation coefficient can be described by an effective atomic number and the electron density of the absorber in the case of an arbitrary mixture of absorbing materials and a continuous X-ray spectrum. These two unknown material parameters can be determined by a method based on the measurement of two spectra with different spectral distribution. This is demonstrated by a one-dimensional and a two-dimensional computer simulation.

48797 **Computationally convenient parameterisation of experimental angular distributions of low energy electrons elastically scattered off water vapour.** Brenner, D.J. (Los Alamos National Lab., NM (USA)); Zaider, M. (Columbia Univ., New York (USA). Radiological Research Lab.). *Physics in Medicine and Biology;* **29**: No. 4, 443-447(Apr 1984).

In the light of the considerable body of experimental data on elastic scattering angular distributions in water vapour over a wide range of incident energies that have recently become available, the authors decided to use a semi-empirical approach and fit these data in a form suitable for use in Monte Carlo transport codes. The current algorithm analysis is restricted to data for energies between 0.35 and 200 eV. The work has arisen as a result of the need for detailed information about energy deposition in subcellular size sites.

48798 **Summary and analysis of neutron measurements conducted during the 1982 US-CEC personnel dosimetry intercomparison study.** Swaja, R.E.; Sims, C.S.; Greene, R.T. (Oak Ridge National Lab., TN (USA)); Schraube, H.; Berger, G. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Strahlenschutz). *Radiation Protection Dosimetry;* **5**: No. 4, 217-225(1983).

A neutron personnel dosimetry intercomparison study was conducted during April 19-23, 1982, as a joint effort between the United States and the Commission of European Communities. Dosemeters from 48 participating agencies were mounted on cylindrical phantoms and exposed to neutron dose equivalents between 0.48 and 13.91 mSv in nine different radiation fields. Exposure conditions included four mixed field spectra produced using the Health Physics Research Reactor, four mono-energetic neutron fields generated by accelerators, and one 15 cm D_2O moderated californium source spectrum. The performance of TLD-albedo, film, recoil track, fission track, and combination albedo-track personnel dosemeters is assessed based on results obtained during this intercomparison.

6560 Solid State Physics

REFER ALSO TO CITATION(S) 65600048164, 48166, 48714, 48806

48799 **(DOE/ER/10440—7) Microscopic determinations of lattice and electronic structures of solids. Final report, July 1, 1979-June 30, 1984.** Gibbons, P.C. (Washington Univ., St. Louis, MO (USA). Dept. of Physics). Aug 1984. Contract AC02-79ER10440. 18p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84017323.

We have completed the project that was the primary one during the contract period. It is a demonstration that electron energy-loss data in the range from 0.5 KeV to 3 KeV can be analyzed to obtain accurate local-structure information. Two other projects are in progress, in which we study large peaks in excitation spectra that now have no one-particle explanation. Both of these will produce significant new understanding of many-electron effects in atoms and in solids. 12 references.

48800 **Contribution of electronic excitations to the entropy of crystals: The relative stabilities of the hcp, fcc, and bcc structures among the transition metals.** Watson, R.E.; Weinert, M. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] B: Condensed Matter;* **30**: No. 4, 1641-1645(15 Aug 1984).

The entropy contributions to the relative stability of one crystal structure versus another due to electronic excitations are calculated in lowest order. While the electronic contribution is but a small part of the total entropy of a crystal, the change in these terms with change in structure is as large as the entropy changes inferred from experiment. One will not have a complete accounting of such entropy effects until there are detailed estimates of the phonon contributions. However, the present results offer the possibility of dividing the experimental values into electronic and phonon terms and attributing to each the temperature dependence of their leading terms when doing thermodynamic calculations.

48801 **Monte Carlo simulation of dynamic uniaxial strain in two-dimensional Lennard-Jones lattices.** Dodson, B.W.; Taylor, P.A. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Physical Review [Section] B: Condensed Matter;* **30**: No. 4, 1679-1685(15 Aug 1984).

We describe an extension of conventional Monte Carlo techniques which allows simulation of a system of atoms subjected to a dynamic physical process consisting of a sequence of time-variable external conditions. The simulation is based on the approximation of a continuous evolutionary process by the finite concatenation of differentially varying static constraints each of which is treated by Monte Carlo techniques. Such a method can only be used to treat rates which are fast or slow relative to the appropriate characteristic time of the system, but allows modeling of atomic systems too complex to treat with the use of molecular-dynamics techniques. This method is particularly useful on atomistic models of mechanical stress and material yielding, and is used herein to simulate the response of atomic lattices to dynamic uniaxial strain. The results of the simulation are then discussed in the context of shock-wave loading.

6561 Superconductivity

REFER ALSO TO CITATION(S) 65610048186, 48221, 48223, 48327

6570 Theoretical Physics

REFER ALSO TO CITATION(S) 65700048718, 48723

48802 **Temperature independent spherical potential which reproduces exactly the second virial coefficient of nonpolar molecules.** Shaw, M.S.; Johnson, J.D. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Chemical Physics;* **81**: No. 7, 3360-3361(1 Oct 1984).

An expression is derived for a temperature independent spherical potential which reproduces exactly the second virial coefficient for nonpolar molecules given the full anisotropic potential. Comparison is made with the median average over angles and the arithmetic average.

48803 **Resolution of the identity for minimum-uncertainty coherent states: An example related to charged-boson coherent states.** Nieto, M.M. (Theoretical Division, Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 87545). *Physical Review [Section] D: Particles and Fields;* **30**: No. 4, 770-773(15 Aug 1984).

After arguing on intuitive grounds that the minimum-uncertainty coherent states for general potentials are complete, the resolution of the identity for a specific example Vproportional$(z-1/z)^2$ is explicitly derived. It is then shown that these states are a generalization to arbitrary (noninteger) charge of the charged-boson coherent states.

6580 Mathematical Physics

REFER ALSO TO CITATION(S) 65800048654

48804 **(CONF-841105—20) Synthetic acceleration of coarse-mesh S/sub n/ transport calculations.** Khalil, H. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84014721.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; Washington, DC, USA (11 Nov 1984).

The lack of an effective method for accelerating the iterative evaluation of the scattering term has, to date, limited the usefulness of multidimensional nodal S/sub n/ schemes. Although the diffusion-synthetic method is potentially one of the most efficient acceleration techniques, the instability of this method for large mesh widths (when the diffusion equation is conventionally differenced) makes it necessary to apply specially-designed differencing techniques to the solution of the diffusion equation. In this summary, we develop a stable diffusion scheme for synthetic acceleration of nodal S/sub n/ calculations in multidimensional Cartesian geometries and show that the equations of this scheme can be solved in an efficient manner. 12 references.

48805 **(JINR—P4-6074) Coherent reconstruction of the object function.** Toropkov, N.A. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1971. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE84901967.

A possibility of reconstruction of the object function in coherent interpretation is shown. The problem is analysed about the automatic identification of the object function from the compound spectrum using the coherent space filter discrimination.

48806 **Irreversible random and cooperative processes on lattices: Spatial correlations.** Evans, J.W.; Burgess, D.R.; Hoffman, D.K. (Ames Laboratory and Department of Chemistry, Iowa State University, Ames, Iowa 50011). *Journal of Mathematical Physics (New York);* **25**: No. 10, 3051-3063(Oct 1984). Contract W-7405-ENG-82.

For processes where "filling" events occur irreversibly and, in general, cooperatively at the sites of a lattice, the minimal closed hierarchy of rate equations involves only probabilities for (effectively) connected subconfigurations of empty sites. Extended hierarchies of equations for (effectively) disconnected empty subconfigurations couple back to these. Here we consider a solution to the latter via previously developed exact and approximate truncation schemes based on a shielding property of empty sites. Numerical results for several processes are presented for correlation behavior in both autocatalytic and autoinhibitory rate regimes. The asymptotic large separation behavior of the spatial correlations is analyzed most easily by z-transforming the equations with respect to separations and is fundamentally different from that of equilibrium distributions.

70 FUSION ENERGY

48807 **(INIS-mf—4754(No.24)) International bulletin on atomic and molecular data for fusion. No. 24.** Katsonis, K. (ed.). (International Atomic Energy Agency, Vienna (Austria). Atomic and Molecular Data Unit). Jan 1984. 83p. NTIS (US Sales Only), PC A05/MF A01. File Number DE84780556.

This bulletin deals with atomic and molecular data for fusion. A bibliography for the most recent data presented in the document is provided, work in progress is briefly reported: Transport on tokamak plasmas simulation, post collisions of gold ions in helium.

48808 **DOE pursues endless energy.** Lawrence, C. (EPRI Office, Washington, DC). *EPRI (Electric Power Research Institute) Journal;* **9**: No. 7, 32-36(Sep 1984).

DOE's fusion energy program has been one of the most consistently funded programs in this period of federal budget cutbacks.

One reason for a strong federal commitment to the program is that it fulfills the premise of the National Energy Policy Plan; i.e., to develop promising technological innovations to the point where private enterprise can reasonably assess their risks. The government's commitment to fusion was strengthened by the oil interruptions of the early 1970s, as well as by growing environmental concerns about air pollution from fossil fuels and the depletion of these fuels. Although much of the current research is related to the defense program, many in the fusion research community believe the inertial confinement fusion technology also has application for energy development. Current research projects are described and goals for the future are discussed.

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REFER ALSO TO CITATION(S) 70010048914, 48924, 48973, 49017, 49225, 49294, 49296

48809 (AD-A—141464/8) **Influence of collisions on the magnetized ion-ion instability. Memorandum report October 1983-October 1984.** Huba, J.D. (Naval Research Lab., Washington, DC (USA)). 30 Apr 1984. 24p. (NRL-MR—5296). NTIS, PC A02/MF A01.

A preliminary investigation of collisional effects on the magnetized ion-ion instability is made. It is found that ion-neutral collisions have a stabilizing influence in that they stabilize all growing modes for sufficiently large collision frequencies. On the other hand, electron-ion collisions have a destabilizing influence in that modes that are stable in the collisionless regime can be unstable because of electron-ion collisions. Applications of these results to the DNA/NRL laser experiment are discussed.

48810 (AD-A—141568/6) **Advanced concepts theory annual report 1983. Annual report January-December 1983.** (Naval Research Lab., Washington, DC (USA)). 18 May 1984. 129p. (NRL-MR—5330). NTIS, PC A07/MF A01.

Results are presented on a variety of research activities concerned with investigating the radiative properties and x-ray conversion efficiency of dense hot plasmas. In this volume are analyses, discussions and numerical simulations on scaling laws for K-shell line power in Z-pinch plasmas, ionization dynamics and diagnostics, atomic processes, ion beam target interactions, and the radiative behavior of mixtures and their potential application as enhanced radiators.

48811 (CLM-CD—1983-Vol.2, pp 366-375) **Current drive by (1) injection of moderately heavy ions at Mev/nucleon; (2) plasma synchrotron radiation.** Dawson, J.M. (California Univ., Los Angeles (USA). Dept. of Physics). 1983. NTIS (US Sales Only), PC A12/MF A01. File Number TI84780558. (CONF-830452—Vol.2).

From Technical meeting on non-inductive current drive in tokamaks; Abingdon, UK (18 Apr 1983).

Two unconventional means of current drive are discussed; the first, current drive using beams of atoms at about 1 Mev/Nucleon theoretically looks every bit as attractive as RF current drive; the second, current drive by the plasma's own synchrotron radiation holds the possibility for a steady state tokamak without external current drive. The second method appears to be capable of sustaining the current in high temperature plasmas (Tsub(e) >approx. 40 Kev) and might be used with D-D or D-^{3}He reactors if these prove feasible; however, it is difficult to test experimentally.

48812 (CLM-CD—1983-Vol.2, pp 376-387) **Quasi steady state current drive by plasma relaxation.** Bevir, M.K.; Gimblett, C.G. (Euratom/UKAEA Fusion Association, Abingdon (UK). Culham Lab.); Miller, G. (Los Alamos Scientific Lab., NM (USA)). 1983. NTIS (US Sales Only), PC A12/MF A01. File Number TI84780558. (CONF-830452—Vol.2).

From Technical meeting on non-inductive current drive in tokamaks; Abingdon, UK (18 Apr 1983).

According to certain models of plasma behaviour, the application of suitably phased alternating voltages to the toroidal and poloidal circuits of a pinch can maintain the toroidal current if the plasma resistance is not too high. This effect was first predicted as a consequence of plasma models used to describe the interaction between the plasma and the power supplies in reversed field pinches, but may conceivably apply to Tokamaks with a relaxing central region where q < 1. A brief description of the models is given.

48813 (CLM-CD—1983-Vol.2, pp 388-416) **Current drive by means of rotating magnetic fields.** Jones, I.R. (Flinders Univ. of South Australia, Bedford Park. School of Physical Sciences). 1983. NTIS (US Sales Only), PC A12/MF A01. File Number TI84780558. (CONF-830452—Vol.2).

From Technical meeting on non-inductive current drive in tokamaks; Abingdon, UK (18 Apr 1983).

The possibility of current drive by means of rotating magnetic fields is examined.

48814 (CLM-CD—1983-Vol.2, pp 417-421) **Generation of reversed field configurations by RF driven currents.** Kuehnapfel, M.; Tuczek, H. (Essen Univ. (Gesamthochschule) (Germany, F.R.)). 1983. NTIS (US Sales Only), PC A12/MF A01. File Number TI84780558. (CONF-830452—Vol.2).

From Technical meeting on non-inductive current drive in tokamaks; Abingdon, UK (18 Apr 1983).

It has been experimentally observed that toroidal currents reversing the bias field can be generated if only a linear polarized r.f. field is applied. This observation can be qualitatively explained in terms of the "end effect", whereby the induced r.f. currents experience a j-vector x B-vector force while transversing the polar zones of the sphere.

48815 (CLM-CD—1983-Vol.2, pp 422-431) **Current drive and plasma heating by radio-frequency sustainment of relativistic electrons in tokamak plasmas.** Fidone, I.; Fichet, M.; Giruzzi, G.; Granata, G.; Meyer, R.L. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Recherches sur la Fusion Controlee). 1983. NTIS (US Sales Only), PC A12/MF A01. File Number TI84780558. (CONF-830452—Vol.2).

From Technical meeting on non-inductive current drive in tokamaks; Abingdon, UK (18 Apr 1983).

Current drive and plasma heating by a relativistic electron beam sustained by rf power is investigated. The efficiency of the current generated and the power dissipated in a dense plasma for the fast and slow modes near and below the lower hybrid frequency is evaluated for several values of the rf energy flux and the wave frequency.

48816 (CLM-CD—1983-Vol.2, pp 432-437) **Plasma waves for electron current drive in tokamaks.** Moreau, D.; Singh, C.M. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherches sur la Fusion Controlee). 1983. NTIS (US Sales Only), PC A12/MF A01. File Number TI84780558. (CONF-830452—Vol.2).

From Technical meeting on non-inductive current drive in tokamaks; Abingdon, UK (18 Apr 1983).

The dispersion relation of cold plasma waves for electron current drive is examined with examples for TORE SUPRA tokamak. The frequency range is 200 MHz to 60 GHz, the former avoiding strong ion cyclotron damping while the latter ensuring availability of r.f. power. A parametric study of accessibility, wave propagation and polarization is presented.

48817 (CLM-CD—1983-Vol.2, pp 438-441) **Current drive and bootstrap current.** Samain, A. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). 1983. NTIS (US Sales Only), PC A12/MF A01. File Number TI84780558. (CONF-830452—Vol.2).

From Technical meeting on non-inductive current drive in tokamaks; Abingdon, UK (18 Apr 1983).

The possibility of using the bootstrap current in a Tokamak reactor is recalled. Control of this current by modeling the density gradient by action of slow waves on trapped particles is considered.

48818 (CLM-CD—1983-Vol.2, pp 473-495) **Review of ECRH current drive theory.** Lashmore-Davies, C.N. (Euratom/UKAEA Fusion Association, Abingdon (UK). Culham Lab.). 1983. NTIS (US Sales Only), PC A12/MF A01. File Number TI84780558. (CONF-830452—Vol.2).

From Technical meeting on non-inductive current drive in tokamaks; Abingdon, UK (18 Apr 1983).

The mechanism of electron cyclotron current drive based on the Fisch-Boozer asymmetric resistivity mechanism is briefly described and its implications for non-inductive current drive pointed out.

48819 (CLM-CD—1983-Vol.2, pp 496-501) **Effect of the relativistic correction to the resonance condition on electron cyclotron current drive.** Cairns, R.A.; Owen, J. (Saint Andrews Univ. (UK). Dept. of Applied Mathematics); Lashmore-Davies, C.N. (Euratom/UKAEA Fusion Association, Abingdon (UK). Culham Lab.). 1983. NTIS (US Sales Only), PC A12/MF A01. File Number TI84780558. (CONF-830452—Vol.2).

From Technical meeting on non-inductive current drive in tokamaks; Abingdon, UK (18 Apr 1983).

The effect of the relativistic correction to the resonance condition on electron cyclotron current drive is discussed.

48820 (CLM-CD—1983-Vol.2, pp 502-513) **Relativistic effects on current drive by quasi perpendicular electron cyclotron waves.** Farina, D.; Lontano, M.; Pozzoli, R.; Razzini, S. (Consiglio Nazionale delle Ricerche, Milan (Italy)). 1983. NTIS (US Sales Only), PC A12/MF A01. File Number TI84780558. (CONF-830452—Vol.2).

From Technical meeting on non-inductive current drive in tokamaks; Abingdon, UK (18 Apr 1983).

The relativistic effects on current drive by quasi perpendicular electron cyclotron waves are examined.

48821 (CLM-CD—1983-Vol.2, pp 514-520) **ECRH current drive experiments at Culham.** Edlington, T. (Euratom/UKAEA Fusion Association, Abingdon (UK). Culham Lab.). 1983. NTIS (US Sales Only), PC A12/MF A01. File Number TI84780558. (CONF-830452—Vol.2).

From Technical meeting on non-inductive current drive in tokamaks; Abingdon, UK (18 Apr 1983).

Experiments on the superconducting Levitron device have established experimentally the existence of ECRH driven current and demonstrate that its amplitude and scaling are close to the theoretical predictions. Further experiments have been performed on the TOSCA experiment at high power with a directional antenna. The data from these experiments show a variation in plasma resistivity which is consistent with a unidirectional toroidal current driven by the wave. The variation of this current with resonance position demonstrates how the toroidal current is inhibited by the presence of a trapped electron population. Further experiments are planned both on TOSCA and on the CLEO experiment, where higher single pass absorption and the freedom to operate in an otherwise current free stellarator mode will facilitate interpretation.

48822 (CLM-CD—1983-Vol.2, pp 521-528) **Coupling between ECRH-driven and ohmic plasma currents.** Start, D.F.H. (Euratom/UKAEA Fusion Association, Abingdon (UK). Culham Lab.). 1983. NTIS (US Sales Only), PC A12/MF A01. File Number TI84780558. (CONF-830452—Vol.2).

From Technical meeting on non-inductive current drive in tokamaks; Abingdon, UK (18 Apr 1983).

A Fokker-Planck calculation of the interaction between ECRH driven and ohmic currents is presented. For high values of the parallel velocity of the resonant electrons, the current driven by electron cyclotron waves is found to be substantially enhanced as a result of the distortion of the electron distribution function due to the electric field. For absorption by resonant electrons of low parallel velocity the wave-induced distortion tends to reduce the ohmic current.

48823 (CLM-CD—1983-Vol.2, pp 529-545) **Review of the experimental papers.** Motley, R.W. (Princeton Univ., NJ (USA). Plasma Physics Lab.). 1983. NTIS (US Sales Only), PC A12/MF A01. File Number TI84780558. (CONF-830452—Vol.2).

From Technical meeting on non-inductive current drive in tokamaks; Abingdon, UK (18 Apr 1983).

The conference papers on non-inductive current drive experiments are reviewed. Neutral beam drive, RF current drive and relativistic electron beams are considered.

48824 (CLM-CD—1983-Vol.2, pp 546-550) **Review of the theory papers.** Canobbio, E. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). 1983. NTIS (US Sales Only), PC A12/MF A01. File Number TI84780558. (CONF-830452—Vol.2).

From Technical meeting on non-inductive current drive in tokamaks; Abingdon, UK (18 Apr 1983).

The conference papers concerned with theoretical aspects of non-inductive current drives in Tokamaks are reviewed.

48825 (CLM-CD—1983-Vol.2, pp 313-326) **Experiments on current drive by lower hybrid waves in the T7 tokamak.** Alikaev, V.V.; Vdovin, V.L.; Ivanov, D.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1983. NTIS (US Sales Only), PC A12/MF A01. File Number TI84780558. (CONF-830452—Vol.2).

From Technical meeting on non-inductive current drive in tokamaks; Abingdon, UK (18 Apr 1983).

Experiments performed on the T7 tokamak on current drive by lower hybrid waves are reported.

48826 (CLM-CD—1983-Vol.2, pp 327-335) **Toroidal plasma current start-up and sustainment by RF in the WT-2 tokamak.** Tanaka, S.; Kubo, S.; Nakamura, M. (Kyoto Univ. (Japan). Dept. of Physics). 1983. NTIS (US Sales Only), PC A12/MF A01. File Number TI84780558. (CONF-830452—Vol.2).

From Technical meeting on non-inductive current drive in tokamaks; Abingdon, UK (18 Apr 1983).

The first experiment in the WT-2 toroidal device, for which the toroidal plasma current is started up and sustained by RF only, without the ohmic heating power is reported. Here, an initial plasma is produced by a microwave discharge at the electron cyclotron resonance (ECR-plasma) and the LHW is injected.

48827 (CLM-CD—1983-Vol.2, pp 336-342) **Plans for lower hybrid current drive in ASDEX.** Echartt, D.; Brambilla, M.; Brinkschulte, H. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). 1983. NTIS (US Sales Only), PC A12/MF A01. File Number TI84780558. (CONF-830452—Vol.2).

From Technical meeting on non-inductive current drive in tokamaks; Abingdon, UK (18 Apr 1983).

An account is given of the proposals for lower hybrid current drive in ASDEX tokamak.

48828 (CLM-CD—1983-Vol.2, pp 342-355) **Analysis and interpretation of experimental data on the 'critical density' in current drive by lower hybrid waves.** Wegrowe, J.G. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)); Tonon, G. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). 1983. NTIS (US Sales Only), PC A12/MF A01. File Number TI84780558. (CONF-830452—Vol.2).

From Technical meeting on non-inductive current drive in tokamaks; Abingdon, UK (18 Apr 1983).

The "critical density" above which the current drive efficiency is found to drop sharply in experiments might be explained by the onset of a strong interaction of the lower hybrid waves with the ions. A criterion has been proposed to describe this onset: it is the value of the density (only weakly dependent on the pump wave spectrum) at which the ratio z = [vsub(phiparallel)/vsub(eth)]/[vsub(phiperpendicular to)/vsub(ith)] reaches a value of the order of the unity. This criterion is in good agreement with numerous LH experiments (not operating in the "current drive regime"). The "critical density" observed in most current drive experiments is also found to be well described by the same criterion.

48829 (CLM-CD—1983-Vol.2, pp 356-365) **Enhanced conductivity during current drive experiments.** Houtte, D. van; Parlange, F. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherches sur la Fusion Controlee). 1983. NTIS (US Sales Only), PC A12/MF A01. File Number TI84780558. (CONF-830452—Vol.2).

From Technical meeting on non-inductive current drive in tokamaks; Abingdon, UK (18 Apr 1983).

During current drive it is essential to distinguish in the loop voltage drop, the effect of real rf driven current from the decrease in resistivity due to electron heating or to suprathermal electron tail creation. To simulate the response of tokamak parameters to current generation, the solution of the transformer equations is used. Time evolution of the loop voltage in PETULA is successfully simulated by a combination of lower hybrid current drive and a linear fall of the plasma resistance.

48830 (CLM-CD—1983(Vol.2)) **Non-inductive current drive in tokamaks.** Start, D.F.H. (ed.). (UKAEA Culham Lab., Abingdon). 1983. 264p. (CONF-830452—Vol.2). NTIS (US Sales Only), PC A12/MF A01. File Number DE84780558.

From Technical meeting on non-inductive current drive in tokamaks; Abingdon, UK (18 Apr 1983).

Separate abstracts were prepared for each of the included papers. (MOW)

48831 (CONF-840910—15) **Coupled transport and heating in EBT and EBS.** Hedrick, C.L.; Batchelor, D.B.; Chen, G.L.; Goldfinger, R.C.; Hastings, D.E.; Jaeger, E.F.; Lee, D.K.; Owen, L.W.; Spong, D.A.; Tolliver, J.S. (Oak Ridge National Lab., TN (USA); JAYCOR, San Diego, CA (USA)). 1984. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85001110.

From 10. international conference on plasma physics and controlled nuclear fusion research; London, UK (12 Sep 1984).

In ELMO Bumpy Torus (EBT) and EBT-like devices, hot electron rings form at the edge of the warm core plasma. As early as 1975 it was recognized that microwave heating, which plays such a significant role in electron dynamics, should be incorporated into transport models. Recent theoretical microwave heating and transport studies suggest that this is critical for explaining EBT experiments. In particular, descriptions of the electron distribution as a sum of only two distributions (i.e., one for the core and one for the rings) are inadequate to understand either the heating or the losses in any depth. Here we discuss the interplay of heating and transport from a kinetic standpoint and point out phenomena associated with the microwave heating at the fundamental and second harmonic of the electron cyclotron frequency. We also compare and contrast these phenomena for the EBT magnetic configuration to those for a variant of the standard EBT - the ELMO Bumpy Square (EBS).

48832 (CONF-840922—3) **Evolution of low-density Thomson scattering on EBT.** Cobble, J.A. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85001760.

From 5. APS topical conference on high temperature plasma diagnostics; Tahoe City, CA, USA (16 Sep 1984).

The ELMO Bumpy Torus (EBT) confines a low-density, steady-state, microwave-driven plasma. On the basis of favorable initial diagnostic results, major machine upgrades - increases in microwave power and magnetic field - were initiated, and the feasibility of Thomson scattering was considered. From the time of the first laser measurements, in which a two-point spectrum was integrated during 30 or more Q-switched pulses, the Thomson scattering system has evolved into a reliable diagnostic tool that is able to obtain scans along 20 cm of the plasma diameter and to determine the central electron temperature at densities as low as 2 x 10^{11} cm^{-3}. Based on a 25-J ruby laser and a seven-channel polychrometer, the present system (1) reveals a bulk plasma with T/sub e/ = 20 to 100 eV and n/sub e/ = 5 to 10 x 10^{11} cm^{-3} and (2) indicates a suprathermal tail consistent with x-ray measurements. With up to 200 kW of microwave power inside the machine, major problems to overcome were radiation damage to optical materials ($\leq$ 3000 R/h) and plasma coating of windows and dumps.

48833 (CONF-840922—4) **Feasibility of alpha particle measurement by CO_2 laser Thomson scattering.** Hutchinson, D.P.; Vander Sluis, K.L.; Sheffield, J.; Sigmar, D.J. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 22p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85001764.

From 5. APS topical conference on high temperature plasma diagnostics; Tahoe City, CA, USA (16 Sep 1984).

The feasibility of CO_2 laser Thomson scattering from a multi-component burning plasma has been evaluated for the measurement of the velocity distribution of D-T produced alpha particles. The density and velocity distribution of the alpha particles from their initial energy of 3.5 MeV down to near-thermal energies may be measured by small angle ($<1^0$) Thomson scattering. A computer simulation of the experiment indicates that a 100 MW pulsed laser combined with a bank of heterodyne receivers will be able to measure a scattered signal from the alpha particles with a post-detection signal-to-noise ratio of 75 for an assumed alpha density of 7.5 x 10^{11} cm^{-3}.

48834 (DOE/ER/53176—1) **Nonlinear magnetohydrodynamics. Progress report, March 15, 1984-December 31, 1984.** Vahala, G. (College of William and Mary, Williamsburg, VA (USA)). 1984. Contract FG05-84ER53176. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85001338.

Seven abstracts of papers either presented at meetings or submitted for publication are included. (MOW)

48835 (DOE/ET/53003—T1) **Theoretical investigations relevant to magnetic fusion energy research. Research proposal, April 1, 1979.** Kammash, T. (Michigan Univ., Ann Arbor (USA). Dept. of Nuclear Engineering). 1979. Contract AC02-76ET53003. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85001774.

Research on the tandem mirror machines is related to the physics of alpha particles. Included are theoretical studies of the transport and the instabilities that are driven by alphas. Some problems that are associated with neutral beam heating of tandem mirrors are studied. Finally, rf heating of ions in bumpy tori is studied. (MOW)

48836 (DOE/ET/53003—T2) **Theoretical investigations relevant to magnetic fusion research. Research proposal, April 1, 1980.** Kammash, T. (Michigan Univ., Ann Arbor (USA). Dept. of Nuclear Engineering). 1980. Contract AC02-76ET53003. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85001775.

This research effort for the past year can be characterized as diversified in that it covered a wide spectrum of investigations related to the magnetic confinement approach to fusion. Although the emphasis continues to be on Q-enhanced mirror devices several studies have been directed at such alternate concepts as EBT, and some at problems of substantial importance to tokamak confined plasmas. A brief discussion of the various investigations and their relevance to ongoing magnetic fusion experiments is presented.

48837 (DOE/ET/53088—155) **Diffusion of particles in a slowly modulated wave.** Cary, J.R.; Escande, D.F.; Tennyson, J.L. (Texas Univ., Austin (USA). Inst. for Fusion Studies). Aug 1984. Contract FG05-80ET53088. 19p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85000729.

Particle motion in a slowly modulated wave as studied. Recent results for the change in the adiabatic invariant due to separatrix crossing are used to calculate the diffusion coefficient for the adiabatic invariant of a particle moving in an amplitude modulated wave. It is argued that the calculated scaling also holds for the case of a narrow spectrum wave field. The present scaling law due to adiabatic invariant jumps, D/sub J ~ k/sub O/Δv/sub phi/^{3}, differs substantially from the resonance broadening theory result D/sub RB/ ~ W/sub O/sup 3/4//k/sub O/sup 1/2/, where Δv/sub phi/ is the spectral width of the phase velocity, and W/sub O/ is the energy density of the wave field.

48838 (EUR-CEA-FC—1205) **Study of electron density and its fluctuations in tokamaks plasmas by fast infrared interferometry.** Ryter, F. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Recherches sur la Fusion Controlee). Oct 1982. 248p. (In French). NTIS (US Sales Only), PC A11/MF A01. File Number DE84751748.

The electron density knowledge in tokamak plasma is fundamental for controlled fusion research. Its study can be made by interferometric measurement of plasma refraction index. Density and density fluctuation measurements are given for present and future tokamak, the wavelength used must be in the far infrared. The type of interferometer used employs two identical lasers. Waveguide type submillimetric lasers, optically pumped by a CO_2 laser, have been developed and optimized. Detectors used are Schottky diodes. The interferometer allows a radial study of the plasma and presents a great stability during the measurement.

48839 (INIS-mf—8878) **IPF research report.** (Stuttgart Univ. (Germany, F.R.). Inst. fuer Plasmaforschung). 1982. 18p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE84780557.

The activity at IPF during the year 1982 have been influenced by the new project electron cyclotron resonance heating, which has been stipulated with the "Institut fuer Plasmaphysik" in Garching after completion of the projects high-voltage belt pinch and Alfven-wave heating. Design and construction of components necessary for the first-time-operation of the 28 GHz gyrotron at IPF have been finished and preparations are made to use this system together with the W VII a stellarator experiment. In the laser applications department the time-resolved measurements of Thomson-scattering with a periodically pulsed laser at the ASDEX-tokamak have been successfully completed. With the 500 kJ POSEIDON experiment first laser scattering measurement have been performed in the plasma-focus department. Of particular importance, however, are many individual studies on the scaling of neutron emission rates at high currents (2-3 MA), showing an increasing transfer of neutron emission into the macroscopically stable pinch-phase. The duration of this phase is enhanced with increasing current.

48840 (PPPL—2114) **Major results of the electron cyclotron heating experiment in the PDX tokamak.** Hsuan, H.; Bol, K.; Bowen, N.; Boyd, D.; Cavallo, A.; Dimits, A.; Doane, J.; Elder, G.; Goldman, M.; Grek, B. (Princeton Univ., NJ (USA). Plasma Physics Lab.; Maryland Univ., College Park (USA)). Jul 1984. Contract AC02-76CH03073. 39p. (CONF-840311—15). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE84017066.

From 4. international symposium on heating in toroidal plasmas; Rome, Italy (21 Mar 1984).

Electron Cyclotron Heating (ECH) experiments on PDX have been carried out with two 60 GHz pulsed gyrotrons each yielding up to approximately 100 kW. The ECH system used two waveguide runs each about 30 meters long. One run included 5 bends and the other, 7 bends. Predetermined waveguide modes were transmitted. The electron cyclotron waves were launched in narrow beams from both the high field and the low field sides of the plasma torus. The major new physics results are: (1) efficient central electron heating for both ohmic and neutral beam heated target plasmas; (2) alteration of MHD behavior using ECH; (3) identification of the trapped electron population with ECH; and (4) signature of velocity-space time evolution during ECH. In the best heating results obtained, Thomson scattering data indicated a central temperature increase from ≦ 1.5 keV to ≧ 2.5 keV. This occurred with an average density of about 10^{13} cm^{-3} and approximately 80 kW outside-launch ordinary-mode heating.

48841 (PPPL—2117) **PLT ion cyclotron range of frequencies heating program.** Hosea, J.; Bell, R.; Budny, R.; Cavallo, A.; Cohen, S.; Colestock, P.; Hammett, G.; Hovey, J.; Hwang, D.; Kaita, R. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Sep 1984. Contract AC02-76CH03073. 33p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85002125.

Measurements of energetic ions, impurity influx, recycling, and Bernstein waves generated in the plasma core are described for ICRF heating in PLT. Such measurements are being used for several launchers in order to optimize rf power deposition and discharge conditions. Preparations are underway to extend operation to higher rf power levels (~ 5 MW) for the best attainable PLT conditions to permit more reactor-relevant extrapolations.

48842 (PPPL—2124) **Plasma-materials interactions during rf experiments in tokamaks.** Cohen, S.A.; Bernabei, S.; Budny, R.; Chu, T.K.; Colestock, P.; Hinnov, E.; Hooke, W.; Hosea, J.; Hwang, D.; Jobes, F. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Sep 1984. Contract AC02-76CH03073. 49p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85002116.

Plasma-materials interactions studied in recent ICRF heating and lower hybrid current drive experiments are reviewed. The microscopic processes responsible for impurity generation are discussed. In ICRF experiments, improvements in machine operation and in antenna and feedthrough design have allowed efficient plasma heating at RF powers up to 3 MW. No significant loss of energy from the plasma core due to impurity radiation occurs. Lower hybrid current drive results in the generation and maintenance of hundreds of kiloamperes of plasma current carried by suprathermal electrons. The loss of these electrons and their role in impurity generation are assessed. Methods to avoid this problem are evaluated.

48843 (PPPL—2133) **Measurements of low energy neutral hydrogen efflux during ICRF heating.** Cohen, S.A.; Ruzic, D.; Voss, D.E.; Budny, R.; Colestock, P.; Heifetz, D.; Hosea, J.; Hwang, D.; Manos, D.; Wilson, J. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Sep 1984. Contract AC02-76CH03073. 22p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85002126.

Using the Low Energy Neutral Atom Spectrometer, measurements were made of the H^0 and D^0 efflux from PLT during ion cyclotron heating experiments. The application of rf power at frequencies appropriate to fundamental and 2nd-harmonic heating results in a rapid, toroidally uniform rise in the charge-exchange efflux at a rate of about 10^{15} cm^{-2} s^{-1} MW^{-1}. This flux increase is larger at lower plasma currents. The cause of this flux and its impact on plasma behavior are discussed.

48844 (PPPL—2135) **Confinement of fusion reaction products during the fishbone instability.** Heidbrink, W.W.; Hay, R.; Strachan, J.D. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Sep 1984. Contract AC02-76CH03073. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85002123.

The presence of fishbone events in the PDX tokamak is correlated with a reduction in the burnup of 0.8 MeV ^{3}He ions. This reduction is probably caused by distortion of the ^{3}He drift orbits in the helical magnetic fields associated with the instability, resulting in the loss of about 70% of the confined ^{3}He ions in a moderately strong fishbone. Such a nonresonant loss of particles with large orbits indicates that fishbone events may influence 3.5 MeV alphas in ignition experiments.

48845 (PPPL—2138) **Theory and simulation of fishbone-type instabilities in beam-heated tokamaks.** Chen, L.; White, R.B.; Cheng, C.Z.; Romanelli, F.; Weiland, J.; Hay, R.; Van Dam, J.W.; Barnes, D.C.; Rosenbluth, M.N.; Tsai, S.T. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Sep 1984. Contract AC02-76CH03073. 18p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85002128.

Energetic trapped particles are shown to introduce a new unstable solution to the internal kink and ballooning modes in tokamaks. Both the real frequencies and growth rates of the instabilities are comparable to the trapped-particle precession frequency. Simulations including the excitation and particle-loss mechanisms of the internal kink mode are found to reproduce essential features of the fishbones. Furthermore, the energetic trapped particle-induced ballooning modes are shown to be consistent with the associated high-frequency oscillations observed experimentally. Several possible stabilizing schemes are considered.

48846 **(PPPL—2140) Magnetohydrodynamic ballooning instabilities excited by energetic trapped particles.** Weiland, J.; Chen, L. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Sep 1984. Contract AC02-76CH03073. 26p. NTIS, PC A03/MF A01. File Number DE85002114.

A new branch of magnetohydrodynamic ballooning modes is shown to be destabilized by energetic trapped particles. Both the real frequencies and growth rates of the instabilities are comparable to the trapped-particle precession frequencies. The theoretical results are also shown to be consistent with the high-frequency (~ 100 kHz) oscillations observed during the high-power beam-injection experiments in PDX.

48847 **(PPPL—2142) Anomalous transport and confinement scaling studies in tokamaks.** Tang, W.M.; Cheng, C.Z.; Krommes, J.A.; Lee, W.W.; Oberman, C.R.; Perkins, F.W.; Rewoldt, G.; Smith, R.; Bonoli, P.; Coppi, B. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Sep 1984. Contract AC02-76CH03073. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85002127.

In addressing the general issue of anomalous energy transport, this paper reports on results of theoretical studies concerning: (1) the characteristics and relative strength of the dominant kinetic instabilities likely to be present under realistic tokamak operating conditions; (2) specific nonlinear processes relevant to the saturation and transport properties of drift-type instabilities; (3) the construction of semiempirical models for electron thermal transport and the scaling trends inferred from them; and (4) the application of specific anomalous transport models to simulate recent large-scale confinement experiments (TFTR and JET) and current drive experiments.

48848 **(PPPL—2145) Transport of neutral atoms and molecules in TFCX.** Boley, C.D. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Sep 1984. Contract AC02-76CH03073. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85002133.

The distribution of neutrals in the proposed reactor TFCX has been modeled by the 3-D Monte Carlo neutral transport code DEGAS, which has been run in conjunction with the 1-1/2-D time-dependent plasma transport code WHIST. The former code contains the best available treatment of neutral-particle physics, including a selection of wall reflection models. The latter code has a comprehensive set of plasma transport coefficients, an MHD equilibrium package, and provision for source terms such as those involving neutrals. It has a simple scrape-off model involving sound-speed flow to the neutralizer plates. The codes are run in iteration, so that the flux-surface averaged particle and energy sources due to interactions with neutrals are consistent with the plasma profiles. The design considered here has a bottom limiter with a pumping plenum. Results are given for the power balance, the mutually consistent plasma and neutral distributions set up in the edge region, the neutral density in the plenum, and the charge-exchange power deposition and erosion along the limiter.

48849 **(UCID—30201) Running FPT for a D-T neutral injection problem.** Mirin, A.A. (Lawrence Livermore National Lab., CA (USA)). Aug 1984. Contract W-7405-ENG-48. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85001767.

FPT is a combination of 3 codes: (a) Fokker-Planck/Transport module - source = AFP7501, (b) Neutral beam deposition - source = BEAMS22, and (c) Neutral Transport - source = PIT46B. A brief description of the code is given.

48850 **Radiation spectra from an imploding argon gas puff.** Maxon, S.; Wainwright, T. (University of California, Lawrence Livermore National Laboratory, Livermore, California 94550). *Physics of Fluids;* 27: No. 10, 2535-2544(Oct 1984). Contract W-7405-ENG-48.

The one-dimensional magnetohydrodynamic equations coupled with the time-dependent populations of the average ion model are numerically solved for an argon gas puff in a Z-pinch configuration. Time-dependent emission spectra are obtained and compared with experiment. There is agreement for the radiation emitted by the hot gas adjacent to the shock front and apparent disagreement for the cool, dense snowplowed gas adjacent to the outer boundary.

48851 **Theory of ponderomotive stabilization of a magnetically confined plasma.** Similon, P.L.; Kaufman, A.N. (Lawrence Berkeley Laboratory and Physics Department, University of California, Berkeley, California 94720). *Physical Review Letters;* 53: No. 11, 1061-1064(10 Sep 1984). Contract AC03-76SF00098.

A self-consistent description is obtained for the low-frequency evolution of a plasma, the electromagnetic field that confines it, and the amplitude of a high-frequency antenna-driven field. The ponderomotive energy of the system is related to the antenna reactive energy. Equilibrium equations and a variational principle for stability are given in terms of ion and electron ponderomotive forces, magnetization current, and self-consistent modification of the high-frequency field.

48852 **Potassium-seeded wall-stabilized arc source for Stark broadening studies.** Hohimer, J.P. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Review of Scientific Instruments;* 55: No. 9, 1410-1414(Sep 1984). Contract AC04-82AL18087.

A potassium-seeded wall-stabilized arc source has been developed to provide a stable well-characterized plasma in which to measure the Stark broadening parameters of potassium excited-state transitions. Low-pressure (20-Torr argon) operation of the arc source reduces the argon collisional broadening contribution to the Stark-broadened line shapes, while a heated channel wall minimizes radial cataphoresis in the mixed-gas plasma. The arc source is designed for end-on observation and is compatible with far-infrared laser interferometry which is used to determine the effective plasma path length and on-axis electron density over the current operating range of 5—35 A.

48853 **Azimuthal ambipolar potential variations and tandem mirror transport.** Lee, X.S.; Myra, J.R.; Catto, P.J. (Science Applications, Inc., Plasma Research Institute, 934 Pearl Street, Boulder, Colorado 80302). *Physics of Fluids;* 27: No. 9, 2248-2255(Sep 1984). Contract AC03-76ET53057.

Azimuthal ambipolar potential variations are induced by the magnetic drifts in a quadrupole tandem mirror. Consequently, radial E x B drifts occur and contribute along with the magnetic drifts to the total radial flux in a collisional plasma. This effect is studied self-consistently in the resonant-plateau regime assuming Maxwell—Boltzmann electrons along the field lines. A general form exhibiting the contribution of the E x B drifts to the flux is obtained and shown, in general, to be significant. In the square-well limit a particularly transparent form results which illustrates the role of dielectric shielding. When the azimuthal E x B drift and the azimuthal electron diamagnetic drift are equal and in opposite directions, the shielding becomes small and a large induced ambipolar contribution to the flux can occur.

48854 **Development of a differential equation for the ambipolar electric field in a bumpy torus in the low collision frequency limit.** Hastings, D.E. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physics of Fluids;* 27: No. 9, 2372-2374(Sep 1984). Contract AC05-84OR21400.

In a bumpy torus the radial electric field is determined by the constraint of ambipolarity. If both species are dominated by nonresonant diffusion, then the ambipolarity relationship as it is usually formulated is algebraic in the electric field. The solutions of this algebraic equation may have a discontinous first derivative of the electric field. The unphysical situation arises from the neglect of the finite orbit deviation from the pressure surface. If the fluxes are calculated to higher order in the inverse aspect ratio, a second-order differential equation for the electric field is obtained that will give a continuous first derivative for the electric field.

48855 **Radial structure of curvature-driven instabilities in a hot-electron plasma.** Spong, D.A.; Berk, H.L.; Van Dam, J.W. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Physics of Fluids;* **27**: No. 9, 2292-2307(Sep 1984). Contract W-7405-ENG-26;FG05-80ET53088.

A nonlocal analysis of curvature-driven instabilities for a hot-electron ring interacting with a warm background plasma has been made. Four different instability modes characteristic of hot-electron plasmas have been examined: the high-frequency hot-electron interchange (at frequencies larger than the ion-cyclotron frequency), the compressional Alfven instability, the interacting background pressure-driven interchange, and the conventional hot-electron interchange (at frequencies below the ion-cyclotron frequency). The decoupling condition between core and hot-electron plasmas has also been examined, and its influence on the background and hot-electron interchange stability boundaries has been studied. The assumed equilibrium plasma profiles and resulting radial mode structure differ somewhat from those used in previous local analytic estimates; however, when the analysis is calibrated to the appropriate effective radial wavelength of the nonlocal calculation, reasonable agreement is obtained. Comparison with recent experimental measurements indicates that certain of these modes may play a role in establishing operating boundaries for the ELMO Bumpy Torus-Scale (EBT-S) experiment. The calculations given here indicate the necessity of having core plasma outside the ring to prevent the destabilizing wave resonance of the precessional mode with a cold plasma.

48856 **General equilibrium and stability properties of high-β tokamaks.** Ramos, J.J. (Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physics of Fluids;* **27**: No. 9, 2313-2318(Sep 1984). Contract AC02-78ET51013.

An analytic approach to the ideal magnetohydrodynamic equilibrium and stability of large-aspect-ratio tokamak configurations in which the fluid and magnetic pressures are comparable, is developed. It is shown that these configurations are unstable against a pressure gradient driven internal mode whose threshold sets an upper limit to the "second" domain of stability.

48857 **Nonlinear mode conversion of intense ordinary waves into electrostatic upper-hybrid waves.** Lin, A.T.; Lin, C. (Department of Physics, University of California, Los Angeles, California 90024). *Physics of Fluids;* **27**: No. 9, 2208-2211(Sep 1984). Contract AM03-76SF00010.

A high-power ordinary wave launched from the low field side is observed to undergo nonlinear mode conversion process and is partially transformed into a short-wavelength electrostatic upper-hybrid wave at the upper-hybrid layer. The nonlinear conversion process can be explained as due to a periodic modulation of upper-hybrid frequency at twice its value, while the frequency modulation comes from the combination of electron mass oscillation and oscillating density modulation induced by the ordinary wave.

48858 **Absolute growth of coupled forward and backward Raman scattering in inhomogeneous plasma.** Koch, P.; Williams, E.A. (New York Institute of Technology, 1855 Broadway, New York, New York 10023). *Physics of Fluids;* **27**: No. 9, 2346-2350(Sep 1984).

The boundary-value problem describing stimulated Raman scattering induced by a plane coherent electromagnetic wave normally incident upon plasma with a monotonic density profile is solved on a global basis. Propagation of amplified electrostatic waves between the resonant backward- and forward-scattering points and reflection of forward-scattered electromagnetic waves into the resonant backward-scattering region result in an absolute instability. The threshold, growth rate and line spacing for this instability are derived.

48859 **RF-induced stability and transport in axisymmetric tandem mirrors.** Myra, J.R.; D'Ippolito, D.A. (Science Applications, Inc., Plasma Research Institute, Boulder, Colorado 80302). *Physical Review Letters;* **53**: No. 9, 914-917(27 Aug 1984). Contract AC03-76ET53057.

A kinetic theory of the ponderomotive force on a plasma due to an electromagnetic ion cyclotron wave is developed and applied to axisymmetric mirrors. The force due to nonresonant particles is shown to modify the usual magnetohydrodynamics interchange stability criterion. Resonant particle contributions to the force arise from the absorption of photon momentum and spin. This effect drives a radial particle flux, modifies the radial ambipolar potential profile, and couples transport and stability.

48860 **New fluctuation phenomena in the H-mode regime of poloidal-divertor tokamak plasmas.** Slusher, R.E.; Surko, C.M.; Valley, J.F.; Crowley, T.; Mazzucato, E.; McGuire, K. (AT & T Bell Laboratories, Murray Hill, New Jersey 07974). *Physical Review Letters;* **53**: No. 7, 667-670(13 Aug 1984). Contract AC02-76CH03073.

A new kind of fluctuation is observed near the edge of plasmas in the PDX tokamak operating in the "H-mode" (improved-confinement) regime. These fluctuations are evidenced as vacuum-UV and density-fluctuation bursts at well-defined frequencies ($\Delta\omega/\omega <$ or ≈ 0.1) in the range between 50 and 180 kHz. The bursts are correlated, both in space and in time, with changes in the temperature-density product near the plasma edge where large density and temperature gradients develop during the H mode.

48861 **Direct spectroscopic observation of charge-exchange recombination of medium-Z elements in the PLT tokamak.** Skinner, C.H.; Suckewer, S.; Cohen, S.A.; Schilling, G.; Wilson, R.; Stratton, B. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Physical Review Letters;* **53**: No. 5, 458-461(30 Jul 1984). Contract AC02-76CH03073.

We report the first observation of line emission resulting directly from charge-exchange recombination of medium-Z elements injected into a PLT discharge. Transitions due to the radiative cascade immediately following charge-exchange of He-like Al and Sc were observed. One of the newly observed lines, Al XI 3209 A, offers a convenient spectroscopic and medium-Z charge-exchange diagostic due to its long (air) wavelength. Spatial scans provided informatin on the profile of the neutral beam in the plasma.

48862 **Examination of the damage to a graphite probe cap exposed to RF heating in PLT plasmas.** Manos, D.; Bennett, T.; Budny, R.; Cohen, S.; Kilpatrick, S.; Timberlake, J. (Princeton Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **2**: No. 3, 1348-1351(Jul 1984). Contract AC02-76CH03073.

Visual observations, optical microscopy, and Auger spectroscopy are used to determine the effects of ion gyroradii, arcing, sputtering, and/or evaporation caused damage to a probe cap that has been exposed to 460 RF heated PLT plasmas. Arc tracks are seen on the cap, many starting on the ion side at the face of the cap extending upwards and backwards. Calculations are made to determine whether the observed quantity of material lost from the top leading edge of the cap is due to evaporation. Model calculations of the observed damage support the suggestion that the majority of effects are due to synergism between thermalized plasma and fast ions.

48863 **Optical fiber luminosity probe for plasma temperature fluctuation measurements.** Simons, T.D. (Stanford University, Mechanical Engineering Department, High Temperature Gasdynamics Laboratory, Stanford, California 94305). *Applied Optics;* **23**: No. 11, 1807-1811(1 Jun 1984).

This paper describes the theory, development, and experimental application of an instrument designed to measure small relative temperature fluctuations associated with traveling acoustic waves in a combustion plasma by observing potassium line radiation. The instrument has been used successfully to measure relative temperature fluctuations of <0.1% in a combustion plasma under conditions representative of magnetohydrodynamic power generation.

48864 Long pulse DCM dye laser. Weber, P.G. (Los Alamos National Lab., NM). *IEEE (Institute of Electrical and Electronics Engineers) Journal of Quantum Electronics;* **QE-19**: 1200-1202(Jul 1983).

A long-pulse, high-power, flashlamp-pumped dye laser based on the dye DCM (4-dicyanomethylene-2-methyl-6-p-dimethylaminostyryl-4H-pyran) has been developed for applications in plasma diagnostics. The laser uses a modified Korad K1 ruby laser head, and a flashlamp circuit capable of prepulse and simmer enhancement. The bubbling of oxygen or nitrogen gas in the dye solution has been found to increase both pulse power and duration. Experiments performed with a dye tube of 7 mm inside diameter, which exhibits spatially nonuniform lsing, have shown typical peak powers on the order of 400 V with a total pulse duration of 100 microsec and a peak wavelength of 644 nm. Attempts to injection lock a laser with a dye tube of 2 mm inside diameter using up to 75 mV of CW power have resulted in several microseconds locked operation. The short duration of the locked pulse is attributed to the fast heating of the dye by the flashlamp, resulting in wavelength shift and delocking of the output.

48865 Coil design for Heliac, A Helical Axis Stellarator. Materna, P.; Heitzenroeder, P.; Lee, K.L. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey). pp 897-899 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

A proposed Helical Axis Stellarator (Heliac) for high-beta plasma confinement is described. A preliminary design and analysis of loads and stresses is presented.

48866 Closed-loop control of plasma current and toroidal field in RFX. Maschio, A.; Tenti, P. (Istituto Gas Ionizzati del CNR - Associazione EURATOM-CNR - Padova). pp 391-394 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

In the paper the design of a control loop for both plasma current and toroidal field for RFX machine is presented. The requirements of the loads are described and both the static and dynamic performances of the control schemes in terms of precision, response time and stability are discussed. Simulations with different plasma models are then performed to test the behaviour of the control loops under different operating conditions.

48867 MFTF-α+T: An upgrade to the MFTF-B. Nelson, W.D.; Doggett, J.N. (Oak Ridge National Laboratory, Oak Ridge, TN). pp 1297-1301 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Several options for upgrading the MFTF-B physics and nuclear performance have been considered. Early in FY83, these upgrades were proposed to the fusion community. The one most favorably received was the MFTF-α+T. The proposed implementation, shown in Fig. 1, will permit two modes of operation. One mode emphasizes better confinement and higher Q. A physics goal is to achieve a central cell Q of 2. At this point, about one-third of the central cell heating comes from alpha particles. At the proposed Q of 2, the power out of the center cell plasma is twice that of the input power to the plasma. The second operating mode emphasizes high fusion power production and high neutron wall loading in the central cell. This is achieved with a center cell insert module, which promises a wall loading of 2 MW/m^2. This mode will provide a unique opportunity for operating a power-producing blanket section at reactor-like parameters.

48868 Plasma engineering considerations for TASKA-M. Emmert, G.A.; Arendt, F.; Borie, E.; Klingelhoefer, R.; Leppelmeier, G.W.; Maurer, W.; Peterson, R.R.; Santarius, J.F.; Scharer, J.E. (Fusion Power Associates, Madison, WI). pp 861-865 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

TASKA-M is a tandem mirror facility aimed at technology and materials testing with reactor-relevant neutron fluxes and fluences. A high neutron wall loading (1.3 MW/m^2) locally is obtained in the central cell using neutral beam injection at 45° to produce a sloshing ion distribution. The total fusion power is only 6.8 MW. Sufficient space is allocated in the central cell for two blanket test modules and two materials test modules. Electron heating using Landau damping of ion cyclotron waves produces a sufficiently high electron temperature so that electron drag on the hot ions is minimized. In addition, the resulting potential well in the central cell is deep enough to contain a warm plasma which stabilizes the hot mirrorconfined plasma against the DCLC mode. MHD stability is obtained by yin-yang anchors at each end of the central cell. In order to simplify the design and to keep the physics as simple as possible, a thermal barrier is not included.

48869 Plasma engineering design of a compact reversed-field pinch reactor (CRFPR). Bathke, C.G.; Embrechts, M.J.; Hagenson, R.L.; Krakowski, R.A.; Miller, R.L. (Los Alamos National Laboratory, Los Alamos, NM). pp 853-860 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The rationale for and the characteristics of the high-power-density Compact Reversed-Field Pinch Reactor (CRFPR) are discussed. Particular emphasis is given to key plasma engineering aspects of the conceptual design, including plasma operations, current drive, and impurity/ash control by means of pumped limiters or magnetic divertors. A brief description of the Fusion Power-Core integration is given.

48870 Engineering feasibilities for the tilt and shift stabilizations of a spheromak plasma. Saoutic, B.; Choi, C.K. (Fusion Studies Laboratory, Univ. of Illinois, Urbana, IL). pp 627 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Plasma confinement by current carrying rings without external toroidal magnetic field has led to a number of experimental and theoretical investigations into spheromak formation and stability. The purpose of this paper is to investigate, by using analytical model, the engineering feasibilities for the tilting and shifting stabilizations of a spheromak reactor plasma configuration. Based on the energy principle, a rigorous stability criterion against tilting which depends on plasma aspect ratio, current peaking factor, and engineering beta (β /SUB e/) has been established. The authors see that for a β /SUB e/ of 0.3 and for an aspect ratio larger than 3.5, the rotational kinetic energy needed for the tilt stabilization is always limited to 10% of the total thermal energy regardless of current peaking factor. Even in the limiting case of an aspect ratio of 1, all current peaking factors below 1 resulted in the energy ratio less than 10%. It thus appears that the engineering window of stability by gyroscopic stabilization seems fairly large. The stability against the shifting can be achieved by using a curved external field shaping.

48871 A Universal Diagnostic Probe System for Tokamak Fusion Test Reactor. Mastronardi, R.; Cabral, R.; Manos, D. (American Science and Eng. Inc.). pp 1507-1511 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

The Tokamak Fusion Test Reactor (TFTR) being built at Princeton Plasma Physics Laboratory is the largest such facility in the U.S. and places tremendous demands on the instrumentation in general and remote positioning equipment in particular. The Universal Diagnostic Probe System is a mechanism that inserts several types of scientific plasma measuring instruments into the plasma edge of the Fusion Reactor. It operates below the reactor substructure and makes a reliable and accurate insertion approximately 4.5 meters vertically from the stowed position. Provision is also made for rotating the instrumentation at the probe head and its 16 electrical conductors (2 of which are high voltage) 360 degrees at a varying rate, when in the fully extended or stowed position. This system is exposed to harsh environments of temperature (in excess of 200°C), high vacuum (less than 10^{-9} Torr), high radiation levels (4×10^{8} rad (SI)), and high magnetic impulses (150 Tesla/sec), without outgassing contaminants to the fusion plasma.

48872 **Texas Experimental Tokamak impurity injection system.** Terry, D.R.; Connally, W.J.; Leung, W.K.; Rowan, W.L. (Fusion Research Center, The University of Texas at Austin, Austin, Texas). pp 1959-1962 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Summary investigation of impurity transport and measurements of ion temperature are facilitated by injecting controlled quantities of selected impurities into tokamaks as diagnostic probes. The impurity injector now in use on the Texas Experimental Tokamak (TEXT) was designed for reliable, automatic operation. In this system, a thin film of the desired impurity is placed near the edge of the plasma. The light pulse from a Q-switched ruby laser is directed to a preselected point on the target. A small part of the impurity film evaporates and drifts into the plasma. The laser beam may be scanned to many points on the target so that enough impurity pulses can be obtained from a single target to allow a full day's operation. The scanning assembly and associated electronics are designed to operate with minimum intervention and to facilitate rapid repair and modification. The system is fully automatic but also incorporates both remote and local manual control capabilities to permit system calibration and troubleshooting. In the event of component failure, its self-diagnostic capability can indicate the area for repair. The system is demonstrating its effectiveness and reliability in the support of three different experimental programs. Engineering aspects of the system are discussed in this paper.

48873 **Mechanical design of glow discharge cleaning probes and Langmuir probes for TFTR.** Groo, R.C. (Princeton Univ., Plasma Physics Laboratory, Princeton, NJ). pp 1919 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

Design considerations for the two Glow Discharge Cleaning Probes and Langmuir and Langmuir Calorimeter Probes for TFTR are discussed. The two Glow Discharge Cleaning Probes, located on the midplane ports at Bays 'E' and 'N' on TFTR, are short probe mechanisms which function as anodes during the vacuum vessel cleaning process. The Langmuir and Langmuir Calorimeter Probes, located at Bays 'A' and 'E' also on midplane ports, measure current and voltage characteristics at the plasma edge. This allows the calculation of n /SUB e/, electron density, and T /SUB e/, electron temperature, which are used to calculate T /SUB i/, ion temperature. Modified purchased probe mechanisms were used for all four probes. Additional access flanges were added to the Langmuir and Langmuir Calorimeter probes to allow the probe heads to be changed in place. Motor drive modifications were made for all probes to increase the torque and speed characteristics of the probe drive and to avoid interferences with adjacent existing and future diagnostics. The GDC Probe and the Langmuir Probe, both located at Bay 'E' shared a common support frame due to the limited space envelope allowed. The GDC Probe at Bay 'N' and the Langmuir Calorimeter probe at Bay 'A' each required a single support frame. Support frame design was accomplished by using STRUDL, a structural design software package from M.I.T. The frames consist of formed type 304 stainless steel channel sections with bolted, dielectrically insulated, joints using G-10 epoxy glass laminated sheets. The G-10 was also incorporated into the design for the probe mechanism base to eliminate the large surface area of the existing aluminum channel and thereby reduce eddy currents in the frame.

48874 **The scaling of economic and performance parameters of DT and advanced fuel fusion reactors.** Roth, J.R. (Department of Electrical Engineering, University of Tennessee, Knoxville, Tennessee). pp 1894 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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In this study, the plasma stability index beta and the fusion power density in the plasma were treated as independent variables to determine how they influenced three economic performance parameters of fusion reactors burning the DT and four advanced fusion fuel cycles. The economic/performance parameters included the total power produced per unit length of reactor; the mass per unit length, and the specific mass in kilograms/kilowatt. The scaling of these parameters with beta and fusion power density was examined for a common set of engineering assumptions on the allowable wall loading limits, the maximum magnetic field existing in the plasma, average blanket mass density, etc. It was found that the power per unit length decreased as the plasma power density and beta increased. This is a consequence of the fact that the first wall is a bottleneck in the energy flow from the plasma to the generating equipment, and the wall power flux will exceed wall loading limits if the plasma radius exceeds a critical value. If one wished to build an engineering test reactor which produced a burning plasma at the lowest possible initial cost, and without regard to whether such a reactor would ultimately produce the cheapest power, then one would minimize the mass per unit length. The mass per unit length decreases with increasing plasma power density and beta, with the DT reaction being the most expensive at a fixed plasma power density (because of its thicker blanket), and the least expensive at a fixed value of beta, at least up to values of beta of 50%. The specific mass, in kg/kw, which is a rough measure of the cost of the power generated by the reactor, shows an opposite trend. It increases with increasing plasma power density and beta. At a given plasma power density and low beta, the DT reaction gives the lowest specific mass, but at a fixed beta above 10%, the advanced fuel cycles have the lowest specific mass.

48875 **The local area network for the plasma Diagnostics System of MFTF-B.** Lau, N.H.; Minor, E.G. (Lawrence Livermore Nat. Laboratory, Livermore, CA). pp 2079-2083 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The MFTF-B Plasma Diagnostics System will be implemented in stages, beginning with a start-up set of diagnostics and evolving toward a basic set. The start-up set contains 12 diagnostics which will acquire a total of about 800 Kbytes of data per machine pulse; the basic set contains 23 diagnostics which will acquire a total of about 8 Mbytes of data per pulse. Each diagnostic is controlled by a "Foundation System" consisting of a DEC LSI-11/23 microcomputer connected to CAMAC via a 5 Mbits/second serial fiber-optic link and connected to a supervisory computer (Perkin-Elmer 3250) via a 9600 baud RS232 link. The Foundation System is a building block used throughout MFTF-B for control and status monitoring. However, its 9600 baud link to the supervisor presents a bottleneck for the large data transfers required by diagnostics. To overcome this bottleneck the diagnostics Foundation Systems will be connected together with an additional LSI-11/23 called the "master" to form a Local Area Network (LAN) for data acquisition. The Diagnostics LAN has a ring architecture with token passing arbitration.

48876 **Modular design of the advanced Stellarator W VII-AS.** Sapper, J.; Brossmann, U.; Greiger, G.; Wobig, H. (Max-Planck-Institut fur Plasmaphysik, EURATOM Association, Garching). pp 2091-2095 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

The Advanced Stellarator WENDELSTEIN VII-AS is an upgraded version of the existing W VII-A Stellarator at Garching, Germany. Optimized field configuration, modular coil set, improved access for external heating, and increased plasma radius are the main properties of the new device. The aim of this experiment is to investigate a net current free plasma in an Advanced Stellarator configuration produced by various external heating methods (neutral beam injection, electron and ion cyclotron heating). This paper presents a survey of the design features and characteristic data of the newly designed Stellarator experiment W VII-AS and gives some more detailed information on the stress calculation of the nonplanar coils in the modular field system, the manufacturing process of such coils, as well as on the calculation, design and fabrication of the unconventionally shaped modular vacuum vessel, its ports and flanges, and on the assembly of the whole machine. An overview will also be given on the external heating equipment. Finally, a prospect of further Stellarator development will complete this paper.

48877 Design of a multi-channel x-ray spectrometer for TFTR. Kuenhe, F.; Erickson, J.E.; Heuer, R. (Grumman Aerospace Corp., Bethpage, NY). pp 279 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

A multi-channel bent crystal x-ray spectrometer designed for use on the TFTR is described. The instrument is designed to provide space and time dependent measurement of ion temperature, and other parameters such as electron temperature, distribution of impurity charge states, and impurity transport information. The spectrometer, to be located in the basement diagnostic area, is based on physics specifications provided by PPPL scientists. Described in detail are the various elements of each channel, including the linear and rotational mechanisms required to permit adjustment of each channel so they can view chosen chords of plasma and operate over a range of diffraction angles, a fixture to bend the crystals to a 10 meter radius, the large helium filled chamber required to house the spectrometer to minimize x-ray attenuation, a berylium window to permit viewing of the plasma while maintaining the tokamak vacuum, and the design of the radiation shielding for the x-ray position detectors.

48878 Development of procedures to ensure quality and integrity in tandem mirror experiment-upgrade (TMX-U) diagnostics systems. Coutts, G.W.; Coon, M.L.; Hinz, A.F.; Hornady, R.S.; Lang, D.D.; Lund, N.P. (Lawrence Livermore Nat. Laboratory, Univ. of California, Livermore, CA). pp 1124-1127 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

The diagnostic systems for Tandem Mirror Experiment-Upgrade (TMX-U) have grown from eleven initial systems to more than twenty systems. During operation, diagnostic system modifications are sometimes required to complete experimental objectives. Also, during operations new diagnostic systems are being developed and implemented. To ensure and maintain the quality and integrity of the data signals, a set of plans and systematic actions are being developed. This paper reviews the procedures set in place to maintain the integrity of existing data systems and ensure the performance objectives of new diagnostics being added.

48879 Evaluating and tuning system response in the MFTF-B control and diagnostics computers. Palasek, R.; Butner, D.N.; Minor, E.G. (Lawrence Livermore National Laboratory, Univ. of California, Livermore, CA). pp 328-333 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

The software system running on the Supervisory Control and Diagnostics System (SCDS) of MFTF-B is, for the major part, an event driven one. Regular, periodic polling of sensors' outputs takes place only at the local level, in the sensors' corresponding local control microcomputers (LCC's). An LCC reports a sensor's value to the supervisory computer only if there was a significant change. This report is passed as a message, routed among and acted upon by a network of applications and systems tasks within the supervisory computer (SCDS). Commands from the operator's console are similarly routed through a network of tasks, but in the opposite direction to the experiment's hardware. In a network such as this, response time is partially determined by system traffic. Because the hardware of MFTF-B will not be connected to the computer system for another two years, the authors are using the local control computers to simulate the event driven traffic that we expect to see during MFTF-B operation. In this paper they show how we are using the simulator to measure and evaluate response, loading, throughput, and utilization of components within the computer system. Measurement of the system under simulation allows us to identify bottlenecks and verify their unloosening. They also use the traffic simulators to evaluate prototypes of different algorithms for selected tasks, comparing their responses under the spectrum of traffic intensities.

48880 Electrical grounding, shielding, and isolation for the MFTF-B plasma diagnostic system. Deadrick, F.J. (Lawrence Livermore National Laboratory, Univ. of California, Livermore, CA). pp 324-327 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

The electrical grounding, shielding, and isolation of plasma diagnostics on the Mirror Fusion Test Facility (MFTF-B) is a key part of the overall design. The Electromagnetic Interference (EMI) environment in which the Plasma Diagnostics System (PDS) will be required to operate is very harsh. The electrical grounding and shielding design which is being implemented to cope with this environment follows one which has been used successfully on the Tandem Mirror Experiment (TMX) (1). Details of the MFTF-B plasma diagnostics facility, equipment grounding, shielding and isolation, and the cabling system are described in this paper.

48881 A new kind of user interface for controlling MFTF diagnostics. Preckshot, G.; Mead, J.; Saroyan, R. (Lawrence Livermore National Laboratory, Livermore, CA). pp 358-361 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

The Mirror Fusion Test Facility (MFTF) at Lawrence Livermore National Laboratory is faced with the problem of controlling a multitude of plasma diagnostics instruments from a central, multiprocessor computer facility. A 16-bit microprocessor-based workstation allows each physicist entree into the central multiprocessor, which consists of nine Perkin-Elmer 32-bit minicomputers. The workstation provides the user interface to the larger system, with display graphics, windowing, and a physics notebook. Controlling a diagnostic is now equivalent to making entries into a traditional physics notebook.

48882 An x-ray detection system development for Tandem Mirror Experiment Upgrade (TMX-U): Hardware and software. Jones, R.M.; Coutts, G.W.; Failor, B.H. (Lawrence Livermore National Laboratory, University of California, Livermore, California). pp 375-376 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

This x-ray detection system measures the electron Bremstrahlung spectrum from the Tandem Mirror Experiment-Upgrade (TMX-U). From this spectrum, we can calculate the electron temperature. The low energy portion of the spectrum (0.5-40 keV) is measured by a liquid-nitrogen-cooled, lithium-drifted silicon detector. The higher energy spectrometer uses an intrinsic germanium detector to accommodate the 100 to 200 keV spectra. The system proceeds as follows. The preamplified detector signals are digitized by a high-speed A-to-D converter located in a Computer Automated Measurement and Control (CAMAC) crate. The data is then stored in a histogramming memory via a data router. The CAMAC crate interfaces with a local desktop computer or the main data acquisition computer that stores the data. The software sets up the modules, acquires the energy spectra (with sample times as short as 2 ms) and plots it. Up to 40 time-resolved spectra are available during one plasma cycle. The actual module configuration, CAMAC interfacing and software that runs the system are the subjects of this paper.

48883 **An overview of the data acquisition and control system for plasma diagnostics on MFTF-B.** Wyman, R.H.; Deadrick, F.J.; Lau, N.H.; Nelson, B.C.; Preckshot, G.; Throop, A.L. (Lawrence Livermore National Laboratory, Livermore, CA). pp 370-374 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

For MFTF-B, the plasma diagnostics system is expected to grow from a collection of 12 types of diagnostic instruments, initially producing about 1 Megabyte of data per shot, to an expanded set of 22 diagnostics producing about 8 Megabytes of data per shot. To control these diagnostics and acquire and process the data, a system design has been developed which uses an architecture similar to the supervisory/local-control computer system which is used to control other MFTF-B subsystems. This paper presents an overview of the hardware and software that will control and acquire data from the plasma diagnostics system. Data flow paths from the instruments, through processing, and into final archived storage will be described. A discussion of anticipated data rates, including anticipated software overhead at various points of the system, is included, along with the identification of possible bottlenecks. A methodology for processing of the data is described, along with the approach to handle the planned growth in the diagnostic system. Motivations are presented for various design choices which have been made.

48884 **Tokamak reactor plasma engineering studies.** Peny, Y.K.M. (Oak Ridge National Laboratory, Oak Ridge, TN). pp 105 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

Since the NUMAK reactor studies in the early 1970s through the more recent FED-INTOR conceptual designs and presently the exploration of the TFCX concepts, plasma engineering assessments have played a progressively more visible role. The plasma engineering studies aim to elucidate the consequences of various physics models and assumptions as they are embodied in reactor concepts. The studies provide calculations of plasma characteristics and performance parameters as input to the engineering design; supply scaling relations of major plasma parameters to the reactor systems trade-off and sensitivity assessments; and explore for alternate plasma operating approaches to improve device cost-effectiveness and alleviate serious perceived difficulties. Recent examples of plasma engineering assessments include: (1) Computation of plasma burn performance in FED using the Plasma OPeration CONtour (POPCON) plots to reveal satisfactory operating regimes in density and temperature space. (2) Estimate of rf-assisted startup in FED assuming <2 MW supplies. ECRH power to reduce the maximum loop voltage and pulsed power.

48885 **Conceptual design for an AIR CORE 2 MEG-AMP Reversed field experiment.** Hammer, C.F. (Los Alamos National Laboratory, Los Alamos, New Mexico). pp 1516-1519 of Fusion Engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

The Los Alamos CTR Division is involved in the conceptual design of a next phase Reversed Field Pinch experiment. The paper will discuss, in general, some of the physics questions that the experiment will address. Also in more detail it will discuss the engineering parameters and the possible hardware design solutions. The experiment is designed to produce a plasma current of about 2 MA which can be sustained for about 200 ms. The electrical energy for the system is provided by a large motor generator set. An inductive energy store is used to drive the magnetizing and poloidal field windings. A capacitor bank provides the energy for the toroidal field windings. The current in both circuits is maintained by using SCR controlled transformer rectifiers.

48886 **PDX modification to produce a bean-shaped high-beta plasma.** Materna, P.; Chrzanowski, J.; Heitzenroeder, P.; Lee, K.; Pereira, M. (Princeton University, Plasma Physics Laboratory, Princeton, New Jersey). pp 689-694 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

Princeton's PDX tokamak is being converted to produce bean-shaped plasmas which hopefully will reach beta of 10%. The work, which is nearly complete, involves repositioning active coils, adding passive coils, and making external modifications.

48887 **Modeling the coupling of magnetodynamics and elastomechanics in structural analysis.** Bialek, J.; Cecchi, J.L.; Urlickson, M.; Wissenburger, D. (Princeton Plasma Physics Laboratory, Princeton, NJ). pp 51-55 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

An important coupling exists between the electromagnetic and the mechanical dynamics of components in close contact with disrupting tokamak plasmas. When the complete analysis is done, magnetic damping and magnetic stiffness are found to be important effects in the electrical and mechanical transients.

48888 **Experimental study on vertical position control of elongated tokamak plasmas.** Nishi, M.; Abe, M.; Otsuka, M. (Energy Research Laboratory, Hitachi, Ltd., Hitachi-shi). pp 334-337 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

Vertical position instability of elongated tokamak plasmas has been studied experimentally on the Hitachi Tokamak (HT-1). Growth rates of the position instability and limits for the active controllability were evaluated. The results were compared with an analysis based on the circuit model, with good agreement demonstrated between them.

48889 **Time-resolved X-ray spectrometry of UV laser produced plasmas.** Marjoribanks, R.S.; Richardson, M.C.; Delettrez, J.; Letzring, S.; Seka, W. (Univ. of Rochester, NY). *Optics Communications;* **44**: No. 2, 113-116(15 Dec 1982). Contract AC08-80DP40124.

Preliminary experiments using an X-ray streak filter spectrometer employing a Au/CsI bifurcated photocathode to investigate the X-ray history of UV (350 nm) laser produced plasmas are reported. Novel use of the streak spectrometer permits a direct and precise fiducial record of the laser pulse to be made from specularly scattered laser light, in true streak time relative to the X-ray record. Initial data indicates a constant 700 eV temperature during the laser pulse; time-resolved particulars are compared to simulations made by the design code LILAC.

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48890 (CLM-CD—1983-Vol.2, pp 442-466) **Driver options and burn cycle selection based on power reactor considerations.** Ehst, D.A. (Argonne National Lab., IL (USA)). 1983. NTIS (US Sales Only), PC A12/MF A01. File Number TI84780558. (CONF-830452—Vol.2).

From Technical meeting on non-inductive current drive in tokamaks; Abingdon, UK (18 Apr 1983).

Reactor implications for noninductive current drive are presented based on a number of studies. First, the lower hybrid driver for the STARFIRE reactor is discussed and the disadvantages of this driver are reviewed. Next, the results of an extensive search for a better current driver are presented. A large number of alternatives were compared in a common context, the DEMO reactor, in order to examine their suitability on a standard basis. Finally, the methodology of a study, currently in progress, is described. The goals of this last study are to compare tokamak reactor designs optimized for operation under different burn cycles, in order to assess the actual benefits and costs of pulsed versus steady-state operation.

48891 (CLM-CD—1983-Vol.2, pp 467-472) **Benefits for tokamak reactor magnet design of 'steady-state' operation.** Spears, W.R. (Euratom/UKAEA Fusion Association, Abingdon (UK). Culham Lab.). 1983. NTIS (US Sales Only), PC A12/MF A01. File Number TI84780558. (CONF-830452—Vol.2).

From Technical meeting on non-inductive current drive in tokamaks; Abingdon, UK (18 Apr 1983).

The advantages and disadvantages for tokamak reactor magnet design of steady state operation are considered.

48892 **(CONF-831203—173) Configurational issues and the evolution of the Mirror Fusion Test Facility upgrade.** O'Toole, J.A. (Oak Ridge National Lab., TN (USA)). 1983. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85000951.

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

Lawrence Livermore National Laboratory (LLNL) and the Fusion Engineering Design Center (FEDC) have been conducting a study concerning the upgrade of the Mirror Fusion Test Facility (MFTF). With MFTF-upgrade, program emphasis will begin to shift away from resolving specific issues toward systems integration of all the subsystems of a tandem mirror reactor. All of the upgrade options considered call for deuterium-tritium (D-T)-burning plasmas and, hence, systems integration in the necessary but difficult nuclear environment of a reactor. The preferred option, MFTF-α+T, has three main objectives: (1) to extend physics performance to Q equivalent to 2 in a D-T plasma, (2) to gain experience in tandem mirror systems integration in a nuclear environment, and (3) to provide a unique capability for operating a power-producing section of a fusion reactor at reactor-like parameters. In this paper, the evolution of the MFTF-upgrade configuration to the preferred option is outlined, the important configurational issues for the upgrade are discussed, and a brief description of the selected configuration is presented.

48893 **(CONF-831203—181) Enhancement to the Tektronix PLOT-10 Terminal Control System for creation of graphics metafiles.** Gray, W.H. (Oak Ridge National Lab., TN (USA)). 1983. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85000954.

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

Many data handling and analysis codes at the Oak Ridge National Laboratory (ORNL) use the Tektronix PLOT-10 Terminal Control System to graphically display data upon Tektronix or Tektronix-emulating graphics devices. Prior to the development of the software libraries and postprocessors discussed within this report, ORNL users were limited to the type of hardcopy output obtainable from the Tektronix PLOT-10 software library. Only Tektronix graphics devices are supported by the PLOT-10 library. The graphics library presented here eliminates this restriction by implementing a suite of software that optionally creates a graphics metafile within the user's disk area while simultaneously drawing a display image on the screen of a user's Tektronix terminal. This graphics metafile can then be postprocessed onto any of the graphics devices at ORNL via the ORNL PLOT command.

48894 **(CONF-831203—182) Computer-based data acquisition system in the Large Coil Test Facility.** Gould, S.S.; Layman, L.R.; Million, D.L. (Oak Ridge National Lab., TN (USA)). 1983. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85000956.

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

The utilization of computers for data acquisition and control is of paramount importance on large-scale fusion experiments because they feature the ability to acquire data from a large number of sensors at various sample rates and provide for flexible data interpretation, presentation, reduction, and analysis. In the Large Coil Test Facility (LCTF) a Digital Equipment Corporation (DEC) PDP-11/60 host computer with the DEC RSX-11M operating system coordinates the activities of five DEC LSI-11/23 front-end processors (FEPs) via direct memory access (DMA) communication links. This provides host control of scheduled data acquisition and FEP event-triggered data collection tasks. Four of the five FEPs have no operating system.

48895 **(CONF-840520—20) Studies on impurity control and hydrogen pumping with chromium gettering in ISX-B.** Mioduszewski, P.; Simpkins, J.E.; Edmonds, P.H.; Isler, R.C.; Lazarus, E.A.; Ma, C.H.; Murakami, M.; Wootton, A.J. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85001896.

From 6. international conference on plasma surface interactions in controlled fusion devices; Nagoya, Japan (14 May 1984).

Chromium gettering has been proven to be a trouble-free and efficient method of surface pumping in tokamaks. The impurity control capabilities are excellent and comparable to that of titanium. The hydrogen uptake is reduced to monolayer quantities on the surface. The expansion of the operating space is similar to that seen with titanium without the disadvantage of strongly increased hydrogen fluxes. Possible applications of chromium gettering are: impurity control in contemporary tokamaks; surface pumping in short pulse DT-burning devices to minimize tritium inventory, and wall conditioning of future large machines prior to operation.

48896 **(CONF-840534—2) Synergistic sputtering properties of binary alloys.** Krauss, A.R.; DeWald, A.B.; Gruen, D.M.; Lam, N.Q. (Argonne National Lab., IL (USA); Georgia Inst. of Tech., Atlanta (USA)). 1984. Contract W-31-109-ENG-38. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE84017493.

From Workshop on synergistic effects in surface phenomena related to plasma-wall interactions; Nagoya, Japan (21 May 1984).

We have found that dilute concentrations of lithium in copper produce surfaces which are nearly pure lithium when heated and subject to irradiation. In order to better understand the experimental results, we have modeled the Cu-Li system using a modified version of the TRIM computer code and an alloy segregation program developed by N.Q. Lam. The TRIM code calculates the sputtering yield and depth of origin of the sputtered atoms for materials in which the composition varies from one atomic layer to the next and the segregation program uses these sputtering yields to trace the evolution of the concentration profile. The initial result of sputtering is to preferentially deplete the surface species. Continued irradiation, however, creates a subsurface region of high displacement damage. In the Cu-Li alloy, lithium moves very rapidly through this region, resulting in subsurface lithium enrichment. The enriched region broadens and eventually reaches the surface. The exact effect on the lithium concentration in the first two atomic layers depends on the temperature, damage profile, and particle flux. Results of the calculation are presented, along with a discussion of their implications for fusion reactor materials.

48897 **(CONF-840570—12) Structural materials for fusion reactor blanket systems.** Bloom, E.E.; Smith, D.L. (Oak Ridge National Lab., TN (USA); Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38;AC05-84OR21400. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85001860.

From Materials for future energy systems conference; Washington, DC, USA (1 May 1984).

Consideration of the required functions of the blanket and the general chemical, mechanical, and physical properties of candidate tritium breeding materials, coolants, structural materials, etc., leads to acceptable or compatible combinations of materials. The presently favored candidate structural materials are the austenitic stainless steels, martensitic steels, and vanadium alloys. The characteristics of these alloy systems which limit their application and potential performance as well as approaches to alloy development aimed at improving performance (temperature capability and lifetime) will be described. Progress towards understanding and improving the performance of structural materials has been substantial. It is possible to develop materials with acceptable properties for fusion applications.

48898 **(CONF-840910—14) Improvement of beam-heated limiter discharges by continuous pellet fueling in Doublet III.** Sengoku, S.; Abe, M.; Hoshino, K.; Itoh, K.; Kameari, A.; Kitsunezaki, A.; Koike, T.; Konoshima, S.; Matoba, T.; Nagami, M. (Oak Ridge National Lab., TN (USA); GA Technologies, Inc., San Diego, CA (USA)). 1984. Contract AT03-80SF11512;AC05-84OR21400. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85001855.

From 10. international conference on plasma physics and controlled nuclear fusion research; London, UK (12 Sep 1984).

A centrifuge pellet injector was employed to produce and maintaun high-density peaked profiles with low edge recycling in the Doublet III (DIII) tokamak. Whereas gas-fueled limiter discharges are characterized by high edge recycling and poor confinement during neutral beam injection, the pellet-fueled limiter discharges exhibit low edge recycling and energy confinement that is similar to diverted H-mode discharges (P-mode). In comparison to gas-fueled discharges, which have a n/sub e/ (0) ~ 1.0 x 10^{14} cm^{-3} and tau/sub E/ ~ 45 ms, the values for pellet fueling were increased to n/sub e/ (0) ~ 2.0 x 10^{14} cm^{-3} amd tau/sub E/ ~ 70 ms at 2.4 MW of beam heating. The neutron production rate was increased from 1 x 10^{11} s^{-1} to 1 x 10^{12} s^{-1}. A technique of interrupting the neutral beam injectors just prior to injecting each pellet resulted in reduced edge ablation and a further enhancement in energy confinement for a peak beam power of 3.2 MW at a 53% duty cycle. Pellet fueling of divertor H-mode plasmas was also studied. In this case, the confinement times are not dramatically improved, but high-density discharges can be produced while maintaining the H-mode.

48899 **(CONF-840916—3) Remote handling requirements and considerations for D-T fusion reactors.** Spampinato, P.T. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85001856.

From Robotics and remote handling in the nuclear industry conference; Toronto, Ontario, Canada (23 Sep 1984).

This paper presents an overview of the maintenance considerations for next-generation fusion reactors. It draws upon the work done at the Fusion Engineering Design Center over the past several years in the conceptual development of tokamaks and tandem mirrors. It specifically addresses the maintenance philosophy adopted for these devices, the configuration development using a modular design approach, scheduled and unscheduled maintenance operations, assembly and disassembly scenarios for component replacements, maintenance equipment requirements, and the operating availability of these devices. In addition, recent work on the development of a totally remote tokamak configuration is presented.

48900 **(DOE/ER/52090—2) ICRF waveguide coupler research. Progress report, July 1983-July 1984.** Scharer, J.E. (Wisconsin Univ., Madison (USA). Dept. of Electrical and Computer Engineering). 1984. Contract AC02-83ER52090. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85001387.

This report highlights results we have obtained on our ICRF (Ion Cyclotron Range of Frequencies) waveguide launcher research during the past year. We have completed an analysis of waveguide aperture launching of waves into a hot plasma with any prescribed edge density and temperature profile. The model Fourier analyzes the waveguide aperture fields and calculates the incident and reflected fast magnetosonic wave fields in the plasma edge region utilizing a stratified slab model. The requirement that the total wave fields at the waveguide-plasma interface match provides the boundary conditions which allow the solution for the plasma input impedance and reflection coefficient.

48901 **(FRNC-TH—1345) Relativistic electron beam interaction with a thin target.** Gazaix, M. (Paris-11 Univ., 91 - Orsay (France)). Mar 1981. 2p. (In French). NTIS (US Sales Only), PC A02/MF A01. File Number DE84751762.

This study is concerned with the increasing possibilities of electron energy deposition in thin targets. The thesis theoretical part studies the relativistic electron beam-plasma instability; the Buneman-Pierce instability in limited medium is also studied. In the experimental part, several questions are tentatively answered: - what is the spatial and temporal evolution of the anode material, in temperature and in density. - What sort of interaction is the beam-target interaction; more particularly questions about focusing and energy deposition are studied.

48902 **(INIS-mf—8863) Investigation of nonlinear processes associated with stimulated Brillouin scattering in an underdense and extended plasma.** Rizvi, S.A.H. (Bochum Univ. (Germany, F.R.). Abt. fuer Physik und Astronomie). 16 Feb 1983. 215p. NTIS (US Sales Only), PC A06/MF A01. File Number DE84780559.

In our experiment, the plasma was performed by means of a Z-pinch. Although a plasma near or above the critical density could have been produced, our experiment was deliberately restricted to underdense plasma as a) our interest was to investigate similar situations as encountered in the large extended coronal region of laser-pellet interaction which may endanger the prospects of laser fusion, b) it is readily accessible to various diagnostic methods, and, c) there is sufficient experimental data and theory availabe for comparison. After a brief introduction of the subject, the theory of laser-induced parametric instabilities, as well as various saturation mechanisms are discussed in the second chapter. The third Chapter contains the experimental details of the complete CO_2 laser system, the Z-pinch, and the laser plasma interaction experiment. Experimental results are reported in the next Chapter and are analyzed in the light of predictions discussed in the second Chapter. A comparison of our results with other experiments is made in Chapter 5, and the discrepancies are explained on the basis of a simple model. The last Chapter sums up the entire work. For a better understanding of the subject, the physics of the laser has been given in Appendix.

48903 **(LBL—18092) Abstracts submitted for the twenty-sixth annual meeting, Division of Plasma Physics, October 29 to November 2, 1984.** (Lawrence Berkeley Lab., CA (USA)). Jul 1984. Contract AC03-76SF00098. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85000202.

48904 **(NRL-MR—5440) Self-generated magnetic fields and thermal flux inhibition.** Emery, M.H.; Gardner, J.H. (Naval Research Lab., Washington, DC (USA)). 28 Sep 1984. 15p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85000206.

We show that the observed thermal flux inhibition in high intensity, short pulse laser-plasma interaction experiments can stem directly from the strong magnetic fields generated at the ablation layer as a result of laser asymmetries. The self-consistent modeling of magnetized thermal transport in this environment shows strong thermal flux inhibition as manifested by reduced ablation pressures, reduced implosion velocities, reduced classical absorption, density profile flattening and reduced mass ablation rates.

48905 **(ORNL/Sub—79-21453/17) 60 GHz Gyrotron Development Program. Quarterly report No. 17, July-September 1983.** Jory, H.R.; Bier, R.E.; Craig, L.J.; Felch, K.L.; Fox, L.J.; Huey, H.E.; Manca, J.; Spang, S.T. 1983. Contract AC05-84OR21400. 54p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE84017314.

The objective of this program is to develop a microwave oscillator capable of producing 200 kW of CW power at 60 GHz. Output mode content of X-6 was measured and found to be a mix of TE_{01}, TE_{02} and TE_{03} modes with unsatisfactory mode purity. Measurements and calculations are reported which indicate that the mode conversion is caused primarily by collector diameter changes. Test results are reported for X-7 which used a 2.5-inch-diameter collector of extended length. Beam power densities are higher than desired. Preliminary analysis of mode conversion was done on a new 4-inch-diameter collector design. The results are quite promising.

48906 **(PPPL—2125) Optical pumping production of spin polarized hydrogen.** Knize, R.J.; Happer, W.; Cecchi, J.L. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Sep 1984. Contract AC02-76CH03073. 18p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85002130.

There has been much interest recently in the production of large quantities of spin polarized hydrogen in various fields, including controlled fusion, quantum fluids, high energy, and nuclear physics. One promising method for the development of large quantities of spin polarized hydrogen is the utilization of optical pumping with a laser. Optical pumping is a process in which photon angular momentum is converted into electron and nuclear spin. The advent of tunable CW dye lasers (~ 1 watt) allows the production of greater than 10^{18} polarized atoms/sec. We have begun a program at Princeton to investigate the physics and technology of using optical pumping to produce large quantities of spin polarized hydrogen. Initial experiments have been done in small closed glass cells. Eventually, a flowing system, open target, or polarized ion source could be constructed.

48907 **(PPPL—2143) Study of stellarator devices by expansion techniques.** Johnson, J.L.; Boozer, A.H.; Koniges, A.E.; Kuo-Petravic, G.; Manickam, J.; Monticello, D.A.; Mynick, H.; Park, W.; Reiman, A.; Rewoldt, G. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Sep 1984. Contract AC02-76CH03073. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85002124.

Expansion techniques have led to new tools for designing stellarators and interpreting experimental results. The stellarator expansion is coupled with Hamiltonian techniques to investigate the effect of plasma pressure on magnetic surface structure. An expansion for nonplanar-axis systems is described. A reduced-equation initial-value formalism is used to create three-dimensional heliac equilibria. A low-β expansion with an auxiliary expansion about the magnetic axis makes possible the determination of island widths in heliacs and allows analytic determination of the effect of equilibrium modifications associated with plasma pressure on radial transport.

48908 **(PPPL—2146) Area Safety Program for the tokamak fusion test reactor (TFTR).** Rappe, G.M. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Oct 1984. Contract AC02-76CH03073. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85002129.

Overall the Area Safety Program has proved to be a very successful operation. There is no doubt that a safety program organized through line management is the best way to involve all personnel. Naturally, when the program was first started, there was some criticism and a certain resistance on the part of a few individuals to fully participate. However, once the program was underway and it could be seen that it was working to everyone's advantage, this reluctance disappeared and a spirit of full cooperation is now enjoyed. It is very important that for this success to continue there must be a two way flow of information, both from the Area Safety Coordinators up through line management, and from senior management, with decisions and answers, back down through the management chain with the utmost dispatch. As with all programs, there is still room for improvement. This program has started a review cycle with a view to streamlining certain areas and possibly increasing its scope in others.

48909 **(SAND—84-1760) Brief outline of analytic stability studies of magnetically insulated systems.** Swegle, J.A. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1984. Contract AC04-76DP00789. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85000212.

This report provides a list of some of the important publications related to the analytic investigation of the linear stability of magnetically insulated systems. Included is a short summary of the work contained in the references.

48910 **(UCID—20166-Vol.2) Special topics reports for the reference tandem mirror fusion breeder. Volume 2. Reactor safety assessment.** Maya, I.; Hoot, C.G.; Wong, C.P.C.; Schultz, K.R.; Garner, J.K.; Bradbury, S.J.; Steele, W.G.; Berwald, D.H. (GA Technologies, Inc., San Diego, CA (USA); TRW Energy Development Group, Redondo Beach, CA (USA)). Sep 1984. Contract W-7405-ENG-48. 70p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85002141.

The safety features of the reference fission suppressed fusion breeder reactor are presented. These include redundancy and overcapacity in primary coolant system components to minimize failure probability, an improved valve location logic to provide for failed component isolation, and double-walled coolant piping and steel guard vessel protection to further limit the extent of any leak. In addition to the primary coolant and decay heat removal system, reactor safety systems also include an independent shield cooling system, the module safety/fuel transfer coolant system, an auxiliary first wall cooling system, a passive dump tank cooling system based on the use of heat pipes, and several lithium fire suppression systems. Safety system specifications are justified based on the results of thermal analysis, event tree construction, consequence calculations, and risk analysis. The result is a reactor design concept with an acceptably low probability of a major radioactivity release. Dose consequences of maximum credible accidents appear to be below 10CFR100 regulatory limits.

48911 **(UCLA/PPG—815) Magnetic fusion energy plasma interactive and high heat flux components. Volume II. Technical assessment of the critical issues and problem areas in high heat flux materials and component development.** Abdou, M.A.; Boyd, R.D.; Easor, J.R.; Gauster, W.B.; Gordon, J.D.; Mattas, R.F.; Morgan, G.D.; Ulrickson, M.A,; Watson, R.D.; Wolfer, W.G,. (California Univ., Los Angeles (USA). Center for Plasma Physics and Fusion Engineering). Jun 1984. 204p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE85001155.

A technical assessment of the critical issues and problem areas for high heat flux materials and components (HHFMC) in magnetic fusion devices shows these problems to be of critical importance for the successful operation of near-term fusion experiments and for the feasibility and attractiveness of long-term fusion reactors. A number of subgroups were formed to assess the critical HHFMC issues along the following major lines: (1) source conditions, (2) systems integration, (3) materials and processes, (4) thermal hydraulics, (5) thermomechanical response, (6) electromagnetic response, (7) instrumentation and control, and (8) test facilities. The details of the technical assessment are presented in eight chapters. The primary technical issues and needs for each area are highlighted.

48912 **(UCLA/PPG—816) Magnetic fusion energy plasma interactive and high heat flux components. Volume III. Strategy for international collaborations in the areas of plasma materials interactions and high heat flux materials and components development.** Gauster, W.B.; Bauer, W.; Roberto, J.B.; Post, D.E. (California Univ., Los Angeles (USA). Center for Plasma Physics and Fusion Engineering). Jan 1984. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85001145.

The purpose of this summary is to assess opportunities for such collaborations in the specific areas of Plasma Materials Interaction and High Heat Flux Materials and Components Development, and to aid in developing a strategy to take advantage of them. After some general discussion of international collaborations, we summarize key technical issues and the US programs to address them. Then follows a summary of present collaborations and potential opportunities in foreign laboratories.

48913 **(UCRL—91511) Computational plasma physics and supercomputers.** Killeen, J.; McNamara, B. (Lawrence Livermore National Lab., CA (USA)). Sep 1984. Contract W-7405-ENG-48. 32p. (CONF-840932—2). NTIS, PC A03/MF A01; GPO Dep. File Number DE85001739.

From Meeting on plasma physics; Trieste, Italy (24 Sep 1984).

The Supercomputers of the 80's are introduced. They are 10 to 100 times more powerful than today's machines. The range of physics modeling in the fusion program is outlined. New machine architecture will influence particular codes, but parallel processing poses new coding difficulties. Increasing realism in simulations will require better numerics and more elaborate mathematics.

48914 **<rhoR> measurements in laser-produced implosions using elastically scattered ions.** Kacenjar, S.; Goldman, L.M.; Entenberg, A.; Skupsky, S. (Laboratory for Laser Energetics, University of Rochester, Rochester, New York 14623). *Journal of Applied Physics;* **56**: No. 7, 2027-2032(1 Oct 1984). Contract AC08-80DP40124.

The measurement of the number of elastically scattered deuterium and tritium ions is shown experimentally to be an effective means of determining the <rhoR> of the fuel in a laser fusion implosion. A method is described for clearly separating the unwanted proton background signal from the desired d and t knockon signals. The details of the analysis are presented for an experiment resulting in a measured <rhoR> of 1.2×10^{-3} g/cm^2.

48915 **Magnetic field errors in bumpy torus configurations.** Hazeltine, R.D.; Catto, P.J. (Science Applications, Inc., Plasma Research Institute, 934 Pearl Street, Boulder, Colorado 80302). *Physics of Fluids;* **27**: No. 9, 2268-2271(Sep 1984). Contract AC03-76ET53057.

The effects of magnetic field errors in a bumpy torus confinement devices are studied. The analysis relies on large-aspect-ratio and near-axis approximations, but includes toroidal effects and allows for any shape of the magnetic field bumps. The main features of the present results agree with those of previous numerical studies. However, the analysis of field line trajectories can be made surprisingly explicit and reveals some features which have not been anticipated.

48916 **Thresholds of convective Raman backscattering: Effects of deln, Thomson scattering, noise, collisions, and Landau damping.** Estabrook, K.; Kruer, W.L. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Physical Review Letters;* **53**: No. 5, 465-468(30 Jul 1984). Contract W-7405-ENG-48.

Using kinetic simulations we find that Raman backscattering can exist for laser intensities a factor 2π lower than the density gradient (deln) threshold and that Thomson scattering can account for backscattering signals even lower. In addition, kinetic, collisional simulations show that laser intensities > or ≈3—10 times the electron-ion collisional threshold are needed for significant Raman absorption. Collisions can also reduce the heat electron temperatures for delnnot =0.

48917 **Shielding analyses and trade-off studies for TFCX inboard shield.** Yang, S.T.; Gohar, Y. (Argonne National Laboratory, 9700 S. Cass Avenue, Argonne, IL 60439). *Transactions of the American Nuclear Society;* **46**: 625-627(Jun 1984). (CONF-840614—).

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

48918 **Magnet shielding in the compact fusion technology test facility TASKA-M.** Sawan, M.E.; El-Guebaly, L.A. (Fusion Power Associates, 6515 Grant Teton Plaza, Madison, WI 53719). *Transactions of the American Nuclear Society;* **46**: 631-633(Jun 1984). (CONF-840614—).

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

48919 **Analysis of the major labyrinths in the test cell of the TFTR.** Kolibal, J.; Long-poe Ku. (Princeton University, Plasma Physics Laboratory, P.O. Box 451, Princeton, NJ 08544). *Transactions of the American Nuclear Society;* **46**: 623-625(Jun 1984). (CONF-840614—).

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

48920 **Activation analyses for the direct convertor collector plates of a tandem mirror reactor.** El-Guebaly, L.A.; White, A.M. (University of Wisconsin, Madison, WI 53706). *Transactions of the American Nuclear Society;* **46**: 622-623(Jun 1984). (CONF-840614—).

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

48921 **Computer graphics support for remote handling simulation and operation.** Leinemann, K.; Schlechtendahl, E.G. (Kernforschungszentrum Karlsruhe, Postfach 3640, D-7500 Karlsruhe 1). *Transactions of the American Nuclear Society;* **46**: 771-772(Jun 1984). (CONF-840614—).

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

48922 **The status of fusion reactor maintenance.** Fuller, G.M. (McDonnell Douglas Astronautics Co., P.O. Box 516, St. Louis, MO 63166). *Transactions of the American Nuclear Society;* **46**: 770-771(Jun 1984). (CONF-840614—).

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

48923 **Magnetic field penetration into liquid metal blankets.** Shercliff, J.A. (Cambridge Univ. Eng. Dept., Cambridge). pp 211-214 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1984). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

In a Tokamak fusion reactor the magnetic field consists of a strong steady toroidal field together with a weaker poloidal field which varies during the programmed operating cycle and also in response to fluctuations of the confined plasma. To reach the plasma, the controlled variations produced by the poloidal field coils have to diffuse through blanket and other structure, much of it electrically conducting, the penetration being inhibited by eddy currents. This paper considers the changes which occur when much of the blanket region consists of liquid lithium and when the scale of the system and the frequency of the changes are high enough for penetration to switch from being only a diffusion process to being a wavelike process also. The skin currents which occur in a solid medium are dispersed into the interior of the fluid by the Alfven wave mechanism. The paper distinguishes between two categories of problems: those where pressure gradients are inactive and wavelike field penetration occurs readily; and those where pressure gradients build up and field penetration involves both diffusion and propagation.

48924 **Fusion reactor development: A review.** (W.M. Stacey, Jr. School of Nuclear Engineering, Georgia Institute of Technology, Atlanta, Georgia). pp 129-222 of Advances in nuclear science and technology. Lewins, J.; Becker, M. New York, NY, USA; Plenum Publishing Corp. (1983).

This paper is a review of the current prospects for fusion reactor development based upon the present status in plasma physics research, fusion technology development and reactor conceptual design for the tokamak magnetic confinement concept. Recent advances in tokamak plasma research and fusion technology development are summarized. The direction and conclusions of tokamak reactor conceptual design are discussed. The status of alternate magnetic confinement concept research is reviewed briefly. A feasible timetable for the development of fusion reactors is presented.

48925 **Contributions to the thermal power of continuously processed TMHR molten salt blankets.** Patterson-Hine, F.A.; Davidson, J.W.; Klein, D.E. (Mechanical Engineering Department, The University of Texas at Austin, Austin, Texas). pp 988-992 of Fusion engineering, Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

In the Be/MS fission-suppressed blanket concept, a thorium-bearing molten fluoride salt is used to breed ^{233}U and is slowly circulated for on-line processing. The effects of fission and activation product buildup on the blanket power densities have been assessed for a variety of processing and blanket performance constraints. Three levels of salt processing have been modeled and the equilibrium uranium concentration in the salt has been varied from 0.11% to 1.0 ^{233}U in thorium. The resulting blanket energy multiplication ranged from 1.56 for the lower uranium concentration to 3.40 for the higher concentration. Corresponding power densities in the blanket region were found to be 1.06 and 2.40 MW/m^3, respectively. Decay heat in this region ranged from 0.09 MW/m^3 for the 0.11% ^{233}U case to 0.19 MW/m^3 for the 1% ^{233}U case. The level of salt processing was found to have little effect on the decay heat rates during reactor operation; however, significant effects were observed during the decay period after reactor shutdown.

48926 **Development of target capsules for Muon Catalyzed Fusion experiments.** Watts, K.D.; Caffrey, A.J.; Jones, S.E. (EG & G Idaho, Inc., Idaho Falls, ID). pp 1143-1147 of Fusion engineering, Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

A series of Muon Catalyzed Fusion experiments has been conducted at the Los Alamos Meson Physics Facility to determine how many fusion reactions one muon would catalyze under various temperature, pressure, contamination, and tritium concentration conditions. Target capsules to contain deuterium and tritium at elevated temperatures and pressures were engineered for a maximum temperature of 540 K (512°F) and a maximum pressure of 103 MPa (15,000 psig). Experimental data collected with these capsules indicated that the number of fusion reactions per muon continued to increase with temperature up to the 540-K design limit. Theory had indicated that the reaction rate should peak at approximately 540 K, but this was not confirmed during the experiments. A second generation of capsules which have a maximum design temperature of 800 K (980°F) and a maximum design pressure of 103 MPa (15,000 psig) has now been engineered. These new capsules will be used to further study the muon catalysis rate versus deuterium/tritium mixture temperature.

48927 **Isotopically tailored HT-9 Steel for radioactive waste management.** Gordon, J.D.; Suchard, S.N.; Thompson, J.J. (TRW Energy Development Group, Redondo Beach, CA). pp 1260-1266 of Fusion engineering, Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The Mirror Advanced Reactor Study (MARS) has developed the design of a first-generation tandem mirror reactor for commercial electric power applications. The goals for the MARS design include physics, technology, economics, safety and environmental compatibility of the reactor; we desired to minimize the volume of material that must be eventually disposed of as radioactive waste and to maximize the fraction of waste suitable for near-surface burial. These desires are somewhat conflicting because minimizing the volume of material is accomplished by increasing its life in the reactor which raises the radioactivity level. There are several questions that must be answered to address long term waste management. These are: What regulations govern disposal of radioactive waste from fusion? What methods can be used to affect the waste rating of a material? What is the cost of affecting the waste rating? The first question relates to governmental regulation. The authors have assumed that the rules for fission waste, as delineated in 10CFR61, could be applied to fusion.

48928 **The conceptual design of a tandem cusp thermonuclear reactor.** Jones, R. (Plasma Physics Group, Physics Department, National University of Singapore). pp 1864-1868 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

The authors have studied various reference designs for classical tandem cusp based fusion power reactors. The classical design is strongly limited by neutron wall loading. Several nonclassical design options are identified which offer the promise of substantial performance improvement.

48929 **Structural design and analysis aspects of heliac (Helical Axis Stellarator).** Zatz, I.J.; Lontai, L.M. (Princeton Univ., Plasma Physics Laboratory, Princeton, NJ). pp 1854-1858 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The HX-1 Heliac, a helical axis stellarator, is a proposed fusion device for the exploration of high beta toroidal confinement with low recirculating power and inherent steady state and stable operation. An infinite aspect ratio for the magnetic well, provided by the helical symmetry of the device, permits these beneficial conditions to exist. The complexities of behavior in a Heliac device required the close collaboration between its design and analysis. The machine design, via analysis, was found to be within allowable performance, dimensional, and structural limits, thereby verifying the integrity of the device. This paper discusses the design methodology and the analytical results in detail.

48930 **Reactor assessments of advanced bumpy torus configurations.** Uckan, N.A. (Oak Ridge National Laboratory, Oak Ridge, TN). pp 1824-1829 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

Recently, several configurational approaches and concept improvement schemes were introduced for enhancing the performance of the basic ELMO Bumpy Torus (EBT) concept and for improving its reactor potential. These configurations include planar racetrack and square geometries, Andreoletti coil systems, and bumpy torus-stellarator hybrids (which include twisted racetrack and helical axis stellarator - snakey torus). Preliminary evaluations of reactor implications of each of these configurations have been carried out based on magnetics (vacuum) calculations, transport and scaling relationships, and stability properties. Results indicate favorable reactor projections with a significant reduction in reactor physical size as compared to conventional EBT reactor designs carried out in the past. Specifically, with these advanced configurations, reactors with R ≃ 20 + or - 3 m are found to be possible; this is almost a factor of 2 reduction in size compared to recent EBT reactor design points with R ≃ 40 + or - 5 m (which utilizes symmetrizing coils for an aspect ratio enhancement) for comparable power outputs. (Here R is defined as 2πR-equivalent major radius.) This makes it possible for operating at high wall loadings (about 2-4 MW/m^2 instead of about 1-1.5 MW/m^2) and increased engineering fusion power density.

48931 **Technical concept of the ASDEX Upgrade Device.** Blaumoser, M. (Max-Planck-Institut fur Plasmaphysik, EURATOM Association, Garching). pp 1814-1818 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

This paper presents the fundamental data of the ASDEX Upgrade Divertor Tokamak presently under construction at IPP, Garching, and describes the technical features of its main components. A time schedule and the present status of the project are also given.

48932 **The mobile reactor concept as applied to testing of compact fusion reactors.** Masson, L.S.; Watts, K.D. (EG & G Idaho, Inc., Idaho Falls, ID). pp 1803-1807 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

Compact fusion reactor concepts have recently received increased emphasis because of advantages principally related to their low cost and short development time. Physics experiments are underway and test results are sufficiently encouraging to merit consideration of "ignition"-type experiments. Since experiments of this nature involve radioactivity, the requirement for test facilities which incorporate remote handling capabilities becomes apparent. One approach to a test facility concept which has particularly attractive features is based on the mobile test reactor concept employing facilities such as are found at the Idaho National Engineering Laboratory (INEL). The mobile reactor test concept was developed in the 1950s and was used extensively in the testing of aircraft nuclear propulsion reactors at the INEL. In this instance, test reactors were assembled on a dolly and were transported to and from test facilities on a fourrail track system. Nuclear operations were conducted from heavily shielded underground control rooms and, for major maintenance operations, the reactors were "unplugged" and returned to a large, centrally located "hot" shop. A similar concept is envisioned for compact fusion reactor testing.

48933 **Alcator DCT conceptual design.** Montgomery, D.B.; Lipschultz, B.; Politzer, P.; Schultz, J.H.; Thome, R.J.; Wolfe, S. (Plasma Fusion Center, Massachusetts Institute of Technology, Cambridge, Massachusetts). pp 2101-2105 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

A 2 meter major radius superconducting tokamak is now under design to serve as a follow-on to the high field Alcator tokamaks at MIT. The machine will be RF heated with 5 MW of CW ICRH, and will be capable of either essentially continuous operation using 4 MW of CW LH current drive, or pulse times of 100 seconds using ohmic drive. The 1 MA plasmas can be elongated up to $\gamma = 1.4$ and will be optionally diverted utilizing a poloidal divertor. The average CW wall and collector heat fluxes will be in the reactor range namely 0.20 MW/m^2 average wall loading, and 2 MW/m^2 average collector loading. The 550 MJ toroidal field system consists of 24 Dee shaped (1.25 X 1.55 m) Nb_3Sn coils with a peak field of 10 T, constructed of internally-cooled conductor similar to that used in the Westinghouse LCP coil. The coils are supported by heavy-wall structural cases, which also contain atmospheric pressure liquid helium. This secondary cooling serves to remove the average heat load from the potted double pancakes, eliminating the need to circulate the internal supercritical helium which provides only a transient stabilization function. The ohmic heating poloidal field coils are also superconducting. The current conductor design is based on an internally cooled NbTi conductor, with a tube-within-a-tube cooling concept. The ohmic heating coils store 120 MJ and provide 35 volt-seconds, with a peak field of 7 T, and an average field change of 3 T/s during the 1.5 s current ramp.

48934 **Construction of the JFT-2M tokamak (1) engineering design and manufacturing.** Narikawa, T.; Asami, N.; Imamura, Y.; Kohri, M.; Nishikawa, M.; Ota, H.; Yamada, M.; Yusuno, Y. (Mitsubishi Electric Co., Tokyo). pp 2106-2112 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

JAERI tokamak JFT-2M is a experimental device with an iron core, which was delivered to JAERI from the Mitsubishi Group in April 1983. It was constructed on a contract with JAERI with purpose of providing a tokamak device with higher performance (achievement of high B plasma with non-circular cross-section, current drive by RF, etc.), taking a little under two years from design to completion. The imposed restrictions, the design and structure of the torus, fabrication procedure at the site, and the record of performance after delivery will be described.

48935 **Design description of the advanced toroidal facility.** Nelson, R.E.; Cain, W.D.; Chipley, K.K.; Cole, M.J.; Foresman, J.W.; Jernigan, T.C.; Johnson, R.L.; Monday, J.F.; Thompson, P.B.; Williamson, D.E. (Oak Ridge National Laboratory, Oak Ridge, TN). pp 2097-2100 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

The Advanced Toroidal Facility (ATF) is a large torsatron being designed at Oak Ridge National Laboratory (ORNL) to replace the Impurity Study Experiment (ISX-B) tokamak. ATF will have a major radius of 2.1 m and an average plasma minor radius of 0.3 m. Major components of the device include the coil sets, structure, and vacuum vessel. The coil sets are designed for broad operating envelopes, including the capability to drive up to 100 kA of plasma current, to produce helical axis configurations, and to operate continuously at one-half the baseline currents. The ATF structure consists of a 40-mm-thick stainless steel toroidal shell encasing the helical coil set. The shell is constructed from 24 identical upper and lower segments, with 12 pairs of intermediate panels to provide access to the helical field (HF) coil joints. The lower portion of the shell also serves as an assembly fixture for the HF coil set. The vacuum vessel is a highly contoured 6-mm-thick stainless steel shell closely fitting the bore and sidewalls of the HF coil winding to provide maximum volume for the plasma. Forty-eight large ports allow good access for diagnostics and neutral beam injection.

48936 **Configuration management of TFTR during final fabrication/assembly/installation.** Sabado, M.; Rappe, G.H.; Stern, E.; Wexler, H. (Ebasco Services Inc.). pp 65-69 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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In essence, configuration management consists of the establishment of a Baseline definition for each project phase, well documented, so that all project participants are conversant with it and the disciplined redefinition of the baseline as the project matures. This paper describes the methods by which the Baseline design for each phase of the TFTR program was updated. Definition was initiated through informal controls which became more formal as the design progressed. At the point where the design was essentially frozen, that is, released for procurement and manufacturing, a configuration change control procedure was instituted to continue on a routine basis both engineering and management review of all changes. Since the TFTR program is experimental in nature it was understood from the outset that desirable changes based on new analytical results and experimental results from other fusion programs could be injected into the design. The problem was one of maintaining the flexibility of providing a reasonable baseline definition, in order to allow the design to proceed yet avoiding the premature freezing of the design, in order to incorporate required changes at lowest cost.

48937 **Quality assurance - Lessons learned in the nuclear power industry.** Cerzosimo, R.R. (United Engineers and Constructors Inc., Philadelphia, PA). pp 70-74 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

The importance of quality assurance in the nuclear industry has risen dramatically and its impact has increased significantly since the NRC published its Quality Assurance Regulations 10CFR50, Appendix B in 1969. In the intervening years, numerous standards dealing with quality assurance have been published by industry and, in connection with these standards, Regulatory Guides have been published by the NRC incorporating these standards into their regulatory guidance requirements. As a result of the analysis of both the TMI-2 accident and recently found quality deficiencies at construction sites for new nuclear power plants, the NRC staff has identified several areas of programmatic requirements needing upgrading to provide greater confidence in the effectiveness of quality assurance (QA) programs for nuclear power plants. The areas of upgrading are intended to provide overall strengthening of the QA program by expanding its formal coverage to additional items and activities, by improving its organizational independence, by improving staffing levels and qualifications of personnel and last, but certainly not least, by emphasizing the need for licensee management to recognize the value of, create, and maintain an effective QA program. Self-initiated evaluations by prospective applicants for an operating license, plus independent design reviews and construction evaluations, are typical of the additional steps taken to raise the level of confidence in the quality of design and construction. This paper addresses and treats the many lessons learned about quality assurance since TMI-2, and relates the actions planned and taken to the ongoing efforts in fusion technology associated with reactor development and performance demonstration.

48938 **Some practical insight into Reliabiliy, Availability and Maintainability.** Braverman, J.R. (U.S. Army Armament Research and Development Command, Dover, NJ). pp 75 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

Practical and basic discussion for management and operating personnel in development, manufacturing and sales of techniques and methods of Reliability, Availability and Maintainability (RAM) utilized in the design and analysis of maintainable systems. Design reliability considerations; probability distributions used in reliability practice; RAM data analyses, RAM indices; and RAM assessments will be addressed and augmented with conventional and short-cut techniques and examples of RAM analysis.

48939 **Configurational issues and the evolution of the Mirror Fusion Test Facility upgrade.** O'Toole, J.A. (Oak Ridge National Laboratory, Oak Ridge, TN). pp 264-268 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

Lawrence Livermore National Laboratory (LLNL) and the Fusion Engineering Design Center (FEDC) have been conducting a study concerning the upgrade of the Mirror Fusion Test Facility (MFTF). With MFTF-upgrade, program emphasis will begin to shift away from resolving specific issues toward systems integration of all the subsystems of a tandem mirror reactor. All of the upgrade options considered call for deuterium-tritium (D-T)-burning plasmas and, hence, systems integration in the necessary but difficult nuclear environment of a reactor. The preferred option, MFTF-α+T, has three main objectives: (1) to extend physics performance to Q about 2 in a D-T plasma, (2) to gain experience in tandem mirror systems integration in a nuclear environment, and (3) to provide a unique capability for operating a power-producing section of a fusion reactor at reactor-like parameters. In this paper, the evolution of the MFTF-upgrade configuration to the preferred option is outlined, the important configurational issues for the upgrade are discussed, and a brief description of the selected configuration is presented.

48940 **d-d compact reversed field pinch reactor technology assessment.** Dabiri, A.E.; Clancy, J.E. (Science Applications Inc., La Jolla, CA). pp 269-272 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A quantitative comparison of the technology requirements, safety performance, and cost of a d-d compact reversed-field pinch reactor (CRFPR) relative to a d-t/CRFPR has been performed. The first wall/blanket and energy-recovery cycle for the d-d reactor is simpler and more efficient than the d-t reactor. In other technology areas (such as magnets and vacuum systems) d-d requirements are not significantly different than the d-t reactor. Tritium technology for processing the plasma exhaust is required for d-d reactors, but no tritium containment around the blanket or heat transport system is needed. Safety analysis shows similar consequences for the release of activated corrosion products or activated first wall/blanket structure. Consequences of all postulated d-d accidents for tritium releases are significantly smaller than those from the d-t reactor. Cost studies have been performed for a series of d-d reactors and compared with a d-t reactor.

48941 **Configuration and layout of the tandem mirror fusion power demonstrator.** Clarkson, I.R.; Neef, W.S. (Grumman Aerospace Corp., Bethpage, NY). pp 254-260 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Studies have been performed during the past year to determine the configuration of a tandem mirror Fusion Power Demonstrator (FPD) machine capable of producing 1750 MW of fusion power. The FPD is seen as the next logical step after the Mirror Fusion Test Facility-B (MFTF-B) toward operation of a power reactor. The design of the FPD machine allows a phased construction: Phase 1, a hydrogen or deuterium checkout machine; Phase 2, a DT "breakeven" machine; Phase 3, development of the Phase 2 machine to provide net power and act as a reactor demonstrator. These phases are essential to the development of remote handling equipment and the design of components that will ultimately be remotely handled. Phasing also permits more modest funding early in the program with some costs committed only after reaching major milestones.

48942 **Assessment of the critical engineering data needs for the commercialization of magnetic confinement fusion.** Waganer, L.M.; Zuckerman, D.S. (McDonnell-Douglas Astronautics Co., St. Louis, MO). pp 245-248 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A survey of twenty-two recent conceptual fusion reactor designs was conducted to ascertain both generic and specific engineering data needs critical for the commercialization of magnetic confinement fusion (MCF). Design experts or advocates for each concept were queried as to the more critical engineering issues and data needs affecting the achievement of commercialization. For each concept, the technical issues were identified and the data needs quantified. Issues and data needs were then ranked based upon the experts' perceptions of the relative importance of each to the concept. The issues encompassed all aspects of the fusion reactor plant design including materials, performance, maintainability, operability, cost, safety and resources.

48943 **An update of the design and capabilities of doublet III in a large dee configuration.** Davis, L.G.; Luxon, J.; Puhn, F.; Rock, P.; Wesley, J. (GA Technologies Inc., San Diego, CA). pp 244 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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In 1985 the Doublet III tokamak will be partially disassembled and reconfigured to a large, dee-shaped plasma cross section (Big Dee). A new dee-shaped vacuum vessel ($R = 1.67$ m, $a = 0.67$ m, $\kappa \leqq 2$) will replace the present indented chamber, and new outer poloidal field coils will be installed with structure to support them and the vessel. Two moveable, pumped, graphite limiters will be installed at the vessel midplane. Armor to protect the vessel from neutral beam incidence and divertor heating will also be installed with provision for pumping of the divertor region at the bottom of the vessel. System design has focused on maximizing the performance of the existing hardware and matching that capability with the new equipment. The primary features of the design are high plasma current/pressure (5 MA/2.4 atm with limiter-defined $\kappa = 2$ dee plasma and 4 MA/1.6 atm with $\kappa = 1.6$ expanded boundary divertor plasmas) and significant long pulse capabilities at more modest plasma current/pressure (2.5 MA/0.6 atm, 30 sec).

48944 **A new economy of scale for small fusion reactor concepts.** Gilligan, J. (Department of Nuclear Engineering, North Carolina State University, Raleigh, North Carolina). pp 234-237 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Mass production of small fusion units and predicted shorter construction times can partially overcome the traditional higher costs ($/kWe) associated with small capacity units. Small fusion units bear some similarity to the combustion gas turbine which has a low capital cost despite its small size (-100 MWe).

48945 **A comparison of mainline and alternate approaches to fusion energy and their application to commercial power production.** Hayman, P.W.; Roth, J.R. (University of Tennessee, Knoxville, TN). pp 227-233 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The tokamak and tandem mirror concepts are compared with alternate confinement concepts using the criteria established in DOE/ET-0047, "An Evaluation of Alternate Magnetic Fusion Concepts 1977". The concepts are evaluated and rated in each of three broad categories: confidence in physics, confidence in technology and reactor desirability. The STARFIRE reactor and Mars reactor were used as a basis for comparing the mainline tokamak and tandem mirror concepts with the 12 alternate concepts evaluated in DOE/ET-0047. Results indicate that the physics of tokamaks and tandem mirrors is better understood than most alternate concepts. Both rank near the middle for technology requirements, and both rank near or at the bottom when compared with the reactor desirability of alternate concepts.

48946 Final design of the MARS end plasma system. Erickson, J.L.; Herbermann, R.J.; Luzzi, T.E.; Sedgley, D.W. (Grumman Aerospace Corp., Bethpage, NY). pp 194-198 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A design of the end plasma system for the Mirror Advanced Reactor Study (MARS) has been completed. The system handles 574 MW of charged particle power leaving the reactor in either the core plasma fan or the halo plasma. Direct conversion produces 293 MW of electrical power. The balance is used to heat water to 320°C. All end plasma system parameters are discussed herein including particle currents and energies, thermal designs, vacuum pumping, tritium transport, nuclear activation, and overall configuration.

48947 Fusion technology development: role of fusion facility upgrades and fission test reactors. Hsu, P.Y.; Deis, G.A.; Longhurst, G.R.; Miller, L.G.; Schmunk, R.E. (EG & G Idaho, Inc., Idaho Falls, ID). pp 1302-1308 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The near term national fusion program is unlikely to follow the aggressive logic of the Fusion Engineering Act of 1980. Faced with level budgets, a large, new fusion facility with an engineering thrust is unlikely in the near future. Within the fusion community the idea of upgrading the existing machines (TFTR, MFTF-B) is being considered to partially mitigate the lack of a design data base to ready the nation to launch an aggressive, mission-oriented fusion program with the goal of power production. This paper examines the cost/benefit issues of using fusion upgrades to develop the technology data base which will be required to support the design and construction of the next generation of fusion machines. The extent of usefulness of the nation's fission test reactors will be examined vis-a-vis the mission of the fusion upgrades. The authors show that while fission neutrons will provide a useful test environment in terms of bulk heating and tritium breeding on a submodule scale, they can play only a supporting role in designing the integrated whole modules and systems to be used in a nuclear fusion machine.

48948 Some technical issues associated with a RIGGATRON Tokamak pure fusion device. Seed, T.J. (INESCO Inc., La Jolla, CA). pp 1309 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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CA 92037-The RIGGATRON Fusion Power Core (FPC) tokamak is a compact fusion reactor concept being developed by INESCO, Inc. A RIGGATRON tokamak is a relatively small device (about 3 meters in diameter) using conventionally-cooled, normal-conducting magnets. Ignition will be achieved primarily using ohmic heating. The toroidal magnetic field ignition requirements are anticipated to be in the 16 to 20 Tesla range. The primary thermal energy recovery and tritium breeding will be placed in a blanket region external to the toroidal magnets. The blanket will be designed to last a reasonable fraction of the plant lifetime, while the FPC will have a 30-day, radiationdamage-limited lifetime. Placing the Toroidal Field (TF) coil next to the plasma shrinks the FPC size and allows the attainment of higher plasma power densities, which shift the plant direct costs from the FPC to the BOP, enhancing both the predictability and competitiveness of fusion plant costs. The present RIGGATRON FPC design allows for a surface heat flux load of 40 MW/M^2, which is required for the high power density achieved in the small FPC. The TF coil design allows the carrying of the mechanical loads created by the high magnetic fields. Its inboard leg sizing and composition is a balance between the TF coil stress, cooling and resistive electrical power loss requirements and those same attributes of the ohmic heating coil. The TF coil outboard leg sizing is a balance between the neutronic performance of the blanket (tritium breeding and high-quality heat production) and the minimization of electrical and nuclear heat deposition in the outer leg (about 1300 MW/M^3).

48949 Engineering considerations in the selection of the tokamak to follow the tokamak fusion test reactor (TFTR). Shannon, T.E. (Oak Ridge National Laboratory, Oak Ridge, TN). pp 1310-1313 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The tokamak to follow the Tokamak Fusion Test Reactor (TFTR) should satisfy two important objectives. First, it should be a significant step in physics and engineering goals in order to maintain the level of progress which the U.S. has established as the world leader in fusion energy development. The second objective should be to provide the information necessary to support the strategy and goals of the long-range Department of Energy (DOE) Fusion Program. In their Comprehensive Program Management Plan, the DOE identifies the need for a reactor technology program in the 1990s in which the major goal is to prove engineering feasibility. In this paper, the specific engineering needs are identified which have been developed through the tokamak design studies over the past decade. On the basis of these needs, it appears that several options are available for the next tokamak to follow TFTR. The final choice of the concept will involve consideration of the technical needs and the reality of the Fusion Program budget.

48950 A high performance, suppressed-fission ICF hybrid. Meier, W.R. (Lawrence Livermore National Laboratory, Univ. of California, Livermore, CA). pp 438-443 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The neutronics aspects of an ICF hybrid concept are discussed. The breeding blanket consists of a beryllium neutron multiplier, metallic thorium fertile fuel and a liquid-lithium coolant. The fertile fuel fraction is 30 vol%, which is much higher than previous one-zone, suppressed-fission hybrid concepts. Fission in the bred ^{233}U is suppressed by competition from tritium breeding reactions in ^{6}Li. The total breeding ratio, $T + F$, is 2.05, and the total neutron energy deposited is 41.1 MeV per DT neutron. The 800-MW (fusion) hybrid produces about 3500 kg of ^{233}U per full-power-year.

48951 Status of INTOR workshop. pp 437 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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INTOR Group (USA, EC, Japan, USSR)-The International Tokamak Reactor (INTOR) Workshop is a collaborative effort among the USA, EC, Japan and USSR, under IAEA auspices, focussed upon an engineering test reactor which would be the next major step in the tokamak program beyond the present generation of large tokamaks. During Phase Zero (1979) the objectives and characteristics of such a device were identified and the status of the supporting technical and scientific data base was assessed. During Phase One (1980-81), a conceptual design was developed. During Phase 2A, Part 1 (1981-83), several critical issues affecting the feasibility and cost of the INTOR design were studied and the design concept was improved. Critical R & D needs have been identified during each Phase of the Workshop. The INTOR Workshop has now entered Phase 2A, Part 2 (1983-85), during which several other critical technical issues will be assessed, the scientific and technological data base assessment of Phase Zero will be upgraded, and the design concept will be further improved. During Phase 2A, Part 1 the following critical issues affecting the feasibility, cost and/or mission definition of a tokamak engineering test reactor were studied: 1) plasma performance; 2) impurity control physics and engineering; 3) engineering test program; 4) tritium; 5) mechanical configuration; 6) magnetics; 7) cost-schedule; and 8) cost-risk benefit. Based on these studies, the design concept was improved in several respects. During Phase 2A, Part 2 the following critical issues affecting the feasibility of a tokamak engineering test reactor are being studied: 1) impurity control physics and engineering; 2) RF heating and current drive; 3) transient electromagentics; 4) remote maintainability; and 5) partitioning of component design and fabrication. The data base assessment is being upgraded, and the design concept will be improved.

48952 **Mechanical and thermal design of the cascade reactor.** Pitts, J.H. (Lawrence Livermore National Laboratory, Univ. of California, Livermore, CA). pp 428-432 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The authors present an improved Cascade fusion reaction chamber that is optimized with respect to chamber radius, wall thickness, and pebble blanket outlet temperature. They show results of a parameter study where we varied chamber radius from 3 to 6 m, wall thickness from 15 to 80 mm, and blanket outlet temperature from 900 to 1400 K. Based on these studies, we achieved an optimized chamber with 50% the volume of the original design and 60% of its blanket. Chamber radius is only 4.4 m and its half length is only 5.9 m, decreased from the original 5-m radius and 8-m half-length. In the optimization method, they calculate both thermal and mechanical stresses resulting from x-ray, fusion-pellet-debris, and neutron-generated momentum, pressure from ablated material, centrifugal action, vacuum inside the chamber, and gravity. They add the mechanical stresses to thermal stresses and keep the total less than the yield stress. Further, they require that fluctuations in these stresses be less than that which would produce creep-fatigue failure within the chamber 30-year lifetime.

48953 **Configurational studies of the TFCX device.** Schmidt, J. (Princeton University Plasma Physics Laboratory, Princeton, NJ). pp 426-427 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Following an early CY83 recommendation by the Magnetic Fusion Advisory Committee (MFAC) that a project definition study be initiated, a plan to carry out scoping (project definition) studies for the Tokamak Fusion Core Experiment (TFCX) was developed. This plan incorporated the engineering and physics resources at the Princeton Plasma Physics Laboratory (PPPL), the Fusion Engineering Design Center (FEDC) and the other fusion laboratories to carry out these studies. Results from these studies will be used to determine the characteristics of the TFCX by the fourth quarter of FY'84. Between the fourth quarter of FY'84 and the end of FY'85 a conceptual design of the total TFCX facility will be completed.

48954 **Quality assurance (QA) for operations of fusion machines as applied to the tandem mirror experiment upgrade (TMX-U).** Chargin, A.K.; Damm, C.C.; Turner, W.C. (Lawrence Livermore National Laboratory, Livermore, CA). pp 525 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Even the best QA plan and its successful execution during construction of a typical fusion machine will produce hardware that is inoperative for some fraction of time. Operating a machine with its hardware out of tolerance, with respect to the specifications, does produce data which is the goal of the experiment. However, a majority of such data are difficult to interpret and may not contribute to understanding the behavior of the experiment. In addition, few fusion machines just operate. The majority of the machines are in the process of being rebuilt and/or added to as they operate. These modifications can keep an otherwise operational machine from running. To insure quality in operation of TMX-U, the authors employ a series of QA procedures. They start with technical milestones, schedules, and budgets that are all negotiated with DOE. Within that framework they implement a total management scheme which, in addition to normal schedule and budget controls, includes: detailed experimental run plans, definition of machine configuration required to accomplish the run plan, subsystem work-ups, instrument calibration, verification of subsystem operation, and repetition of standard physics plasma parameters. All of these activities must be completed before taking data for the experimental run plan. If a subsystem is found out of tolerance, a decision must be made either to delay operation and fix the problem or to continue on a contingency-run plan which should still produce the data relevant to the project milestones. In this presentation those QA procedures for TMX-U operations that are applied to minimize the cost and time required to achieve the technical objectives are discussed.

48955 **Winding of the Westinghouse LCP coil.** Merritt, P.A.; Hampton, T.E.; Udauchak, D.L. (Westinghouse Electric Co., East Pittsburgh, PA). pp 826 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Electric Corp., East Pittsburgh, Pa. 15112 - This paper describes the manufacturing effort and recent accomplishments on the coil being built by Westinghouse for the Large Coil Program. This coil utilizes a Nb_3Sn forced flow cooled superconductor which is wound into grooves, machined into aluminum structural plates. This paper reviews coil winding in four areas. (1) "Facility Planning and Equipment Design", discusses how the winding facility was designed, and what winding equipment is used for coil winding. (2) "Winding tool development and design", describes how the winding tools were designed and how they have evolved during this project. (3) "Winding processes and technique", discusses how the coil is wound and what has been learned so far. (4) "The behavior of Westinghouse Nb_3Sn force flow conductor during winding", describes how the conductor reacts to straightening, and winding and insulating. A general evaluation of winding experience and the lessons learned will also be included.

48956 **Mirror research: Status and prospects.** Baldwin, D.E. (Lawerence Livermore National Laboratory, Livermore, CA). pp 17-33 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The tandem mirror program has evolved considerably in the last decade. Of significance is the viable reactor concept embodied in the MARS design. An aggressive experimental program culminating in the operation of MFTF-B in late 1986, will provide a firm basis for refining the MARS design as necessary for constructing a reactor prototype in the 1990s.

48957 **Plasma engineering analysis of the Tennessee tokamak.** Yokoyama, K.E.; Bryan, W.E.; King, P.W.; Lacatski, J.T.; Miller, J.B.; Santoro, R.T.; Shannon, T.E.; Uckan, N.A. (The University of Tennessee, Department of Nuclear Engineering, Knoxville, Tennessee). pp 628-632 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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This paper summarizes the results of the plasma engineering and systems analysis studies for the Tennessee Tokamak (TENTOK) fusion power reactor. TENTOK is a 3000-MW(t) central station power plant that uses deuterium-tritium fuel in a D-shaped tokamak plasma configuration with a double-null poloidal divertor. The major parameters are R /SUB o/ = 6.4 m, a = 1.6 m, σ (elongation) = 1.65, (n) = 1.5 X 10^{20} m^{-3}, (T) = 15 keV, (β) = 6%, B /SUB T/ (on-axis) = 5.6 T, I /SUB p/ = 8.5 MA, and wall loading = 3 MW/m^2. Detailed analyses are performed in the areas of (1) transport simulation using the one-and-onehalf-dimensional (1 1/2-D) WHIST transport code, (2) equilibrium/poloidal field coil systems, (3) neutral beam and radiofrequency (rf) heating, and (4) pellet fueling. In addition, impurity control systems, diagnostics and controls, and possible microwave plasma preheating and steady-state current drive options are also considered. Some of the major features of TENTOK include rf heating in the ion cyclotron range of frequencies, superconducting equilibrium field coils outside the superconducting toroidal field coils, a double-null poloidal divertor for impurity control and alpha ash removal, and rf-assisted plasma preheating and current startup.

48958 **Diagnostic techniques for measuring temperature transients and stress transients in the first wall of an ICF reactor.** Melamed, N.T.; Taylor, L.H. (Westinghouse R & D Center, Pittsburgh, Pennsylvania). pp 1541-1549 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The primary challenge in the design of an Inertial Confinement Fusion (ICF) power reactor is to make the first wall survive the frequent explosions of the pellets. Westinghouse has proposed a dry wall design consisting of steel tubes coated with tantalum. This paper describes the design of a test chamber and two diagnostic procedures for experimentally determining the reliability of the Westinghouse design. The test chamber simulates the x-ray and ion pulse irradiation of the wall due to a pellet explosion. The diagnostics consist of remote temperature sensing and surface deformation measurements. The chamber and diagnostics can also be used to test other first-wall designs.

48959 **Description of a liquid metal test blanket for TASKA-M.** Sviatoslavsky, I.N.; Swan, M.E.; Sze, D.K. (Fusion Power Associates, Madison, WI). pp 1536-1540 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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TASKA-M is a conceptual design of a low power, low cost test reactor based on a tandem mirror without thermal barriers utilizing physics which is presently in hand, or which should be available by 1985. The main purpose of the reactor is to study plasma engineering and provide a reasonable cost test bed for qualifying materials and investigating different blanket concepts. The central cell which is nominally 4.25 m long is divided into five zones: a liquid metal test blanket module, a solid breeder test blanket module, two material test modules and a central cell shield insert. This paper describes the structural, thermal hydraulics and neutronic aspects of two liquid metal test blanket modules, one utilizing the $Li_{17}Pb_{83}$ eutectic and the other Li. Both blanket modules are designed to fit into the same slot within the central cell and will therefore be tested consecutively. Further, the blanket modules contain one of the four ICRF antennas that are needed to provide plasma heating within the central cell.

48960 **Pressure drop considerations of a lithium cooled fusion breeder tokamak reactor blanket.** Wong, C.P.C. (GA Technologies, San Diego, CA). pp 1888-1893 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Liquid lithium was selected as one of the coolants for the 1983 fusion breeder blanket used on the magnetically confined tokamak fusion reactor, and as a result, the thermal-hydraulic calculations were dominated by magnetohydrodynamic (MHD) considerations. The applicable sets of MHD equations for the engineering thermal-hydraulic design were reviewed and compared. Special attention was given to the MHD calculations for the fertile material zone, a packed bed of composite beryllium and thorium balls, since this region can dominate the thermal-hydraulic behavior of this blanket module. To keep the pressure drops acceptable, fertile fuel balls were omitted in the inboard blanket.

48961 **The impact of key design parameters on neutron wall load in an ignited tokamak.** Riersen, W.T. (Fusion Engineering Design Center/Grumman Aerospace Corporation, Oak Ridge National Laboratory, Oak Ridge, TN). pp 1878-1882 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A study was performed to determine the impact of key design parameters on neutron wall load in an ignited deuterium-tritium (D-T) tokamak. Systems effects of parameter variations were determined using the Fusion Engineering Design Center (FEDC) Systems Code. Poloidal variations in neutron wall load were determined using the Monte Carlo Code for Neutron and Photon Transport (MCNP). The marked impact of key design parameters is quantitatively shown.

48962 **The effect of iron beams in concrete on the fast neutron flux perturbation for fusion reactors.** Ku, L.P.; Kolibal, J.G. (Plasma Physics Laboratory, Princeton, NJ). pp 1869-1872 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The importance of considering fast neutron flux perturbations introduced by vertical steel beams in thick concrete shield is discussed. The study is part of a program which assesses the overall effectiveness of using concrete as a shield in fusion facility design. An illustration is given for iron beams in 1.83 m of limestone concrete. This problem is chosen to simulate the geometry found in TFTR. Using pure iron instead of steel provides a simplified yet conservative approach. While the beam perturbation depends on the details of the geometry and the material compositions, the understanding of the nature of the problem provides a guide for shielding designers to examine the severity of such perturbations.

48963 **Optimization of shield temperatures to maintain cryogenic surfaces at or about 4°K with minimum operating cost.** Pinter, G.R. (Grumman Aerospace Corp., Bethpage, NY). pp 1830-1832 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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If a helium cryopanel shielded with liquid nitrogen panels operates at 4°K, a certain level of refrigerator power is required. With the addition of a second shield, operating at an optimum temperature of approximately 190°K, the refrigeration power requirement will be reduced to 30%-40% of the singleshield case. Basic considerations leading to the above results are presented, together with the results of a specific optimization program. A moderate departure from the optimum temperatures (in order to achieve readily-attainable temperatures by using Freon 13 and nitrogen) will not invalidate the conclusion, that a second shield may significantly reduce the operating cost of cryogenic systems designed to maintain cryogenic surfaces at or about 4°K.

48964 **Methods of implementing neutron albedo control in toroidal fusion reactors.** Jassby, D.L.; Micklich, B.J. (Princeton Univ., Plasma Physics Laboratory, Princeton, NJ). pp 1819 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The magnitude and energy distribution of the neutron current incident on the outboard first wall of a toroidal fusion chamber can be varied greatly by altering the neutron total albedo of the inboard side of the chamber. This paper discusses practical methods of changing out materials behind the inboard first wall in order to vary the inboard neutron albedo in the course of a test program. (a) The albedo is increased by flowing liquid Pb through ducts behind the inboard wall. (b) The albedo is reduced by flowing liquid Li through these ducts. (c) Scattered neutron currents at $E > 300$ keV are reduced significantly by flowing water through the ducts. (d) Reflecting (eg, Pb), absorbing (eg, B_4C), or moderating (eg, C) materials can be introduced in the form of pebbles or microspheres, gravity-fed from the top of the reactor into vertical ducts behind the inboard first wall, and retrieved from the bottom. (e) Slugs of materials of different albedos can be transported vertically on stingers installed in shafts some tens of cm deep just behind the inboard first wall. (f) Massive slabs or arrays of rods composed of neutron reflectors, absorbers or moderators can be transported vertically in these shafts. With different inboard materials in different sectors of the torus, distinct neutron fluxes and energy distributions can be established in azimuthally separated outboard test modules. These concepts are applied to a proposed fusion test reactor design.

48965 **Candidate first-wall materials for fusion reactors.** Bloom, E.E.; Reuther, T.C.; Scott, J.L. (Oak Ridge National Laboratory, Oak Ridge, TN). pp 78 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Among candidate first-wall structural materials for fusion reactors, austenitic stainless steels, ferritic steels, and vanadium alloys have emerged as the front runners. Irradiation lifetimes and temperature limits for each of these classes of systems are being determined. For the austenitic steels, lifetimes in excess of 10 MW-yr/m^2 at temperatures up to 550°C are achievable. Ferritic steels have the potential of even longer irradiation lifetimes, but there may be a low-temperature limit set by the ductile-to-brittle transition-temperature. Vanadium alloys show great promise, but little is known about their properties or response to irradiation. Low-activation representatives of each alloy class appear to be achievable.

48966 **Recent progress in the First Wall/Blanket/Shield Program.** Nygren, R.E. (Argonne National Laboratory, Argonne, IL). pp 79-83 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The results from the First Wall/Blanket/Shield Program during FY1982 and FY1983 are reviewed. Major accomplishments include: e-beam surface heating tests and simulations of melting and vaporization during plasma disruptions, preparation and operation of a 100 kW e-beam facility (ASURF) for surface heating tests, isothermal simulations of Li$_2$ /SUP O/ subjected to helium purge gas for over 1000 hours at 700°C and at 300°C, construction of an electromagnetic test stand (FELIX) and progress in development of eddy current codes, experimental results on electrical contacts capable of carry high currents for sector-to-sector shunts in tokamaks, designs for large remotely-actuated mechanical joints and completion of the first edition of the Designers' Guidebook on Remote Assembly, Maintenance and Repair. The program has recently focused on a narrower scope of critical issues in blanket technology. Current activities in the (renamed) Blanket Technology Program are also briefly reviewed.

48967 **The first wall design of R-tokamak.** Matsuoka, K.; Hamada, Y.; Itoh, Y.; Kikuchi, K.; Kitagawa, S.; Matsuura, K.; Swada, Y.; Tanako, H.; Toi, K.; Tomita, M. (Inst. of Plasma Physics, Nagoya Univ., Nagoya). pp 89-92 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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First wall design is described for the R-tokamak where the vacuum vessel is made of aluminum alloy from the standpoint of low activation. Because of high thermal conductivity of Al-alloy we can adopt active water (or gas)-cooling of the outer surface of the vacuum vessel to avoid over-aging of Al-alloy and to suppress the temperature rise of TiC-coated graphite limiter to a reasonable level. The method having no cooling pipe inside the vacuum vessel is superior in simplicity.

48968 **Aspects of long pulse commercial tokamak reactor design.** LeClaire, R.J.; Bromberg, L.; Cohn, D.R.; Meyer, J.E.; Williams, J.E.C. (Massachusetts Institute of Technology, Cambridge, MA). pp 249-253 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Possibilities of very long burn pulse operation in commercial tokamak reactors are analyzed. Long pulse operation could reduce or eliminate lifetime limits due to fatigue in the first wall, blanket and structural material and make the reactor more attractive from the standpoint of the electric utility. Very long pulse lengths can be achieved with tokamaks using inductive current drive if the major radius is increased to accomodate a large ohmic transformer. Illustrative design parameters have been developed for an Ultra-Long Pulse Tokamak Reactor (ULTR) with a pulse length of 24 hours. The principles developed for the 24 hour pulse length ULTR design have also been used in a scoping study for machines with shorter pulses. Parameters for a machine with a 4 hour pulse length are given. The ULTR design has an ohmic transformer which is optimized to satisfy the conflicting requirements of maximized OH drive and for reaction of the inward forces of the TF coil. The toroidal field magnet is completely modularized, with each coil in its own cryostat and shearing panels at room temperature. Analysis of effects of thermal fatigue on a representative first wall design has been performed. Windows of allowed operation have been found, limited by primary stress, swelling and fatigue. The analysis has been carried out for first walls made of stainless steel or vanadium.

48969 **A tritium breeding and electricity generating blanket sector for INTOR/NET.** Challender, R.; Baker, L.; Bond, A.; Coast, G.; Kennedy, P.; Mitchell, N.; Orr, D.; Reynolds, P.; Thompson, V. (United Kingdom Atomic Energy Authority, Risley). pp 238-243 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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This study of a fusion reactor power blanket and associated equipment had the objective of a demonstration experiment in INTOR or in one of its national variants (eg NET). A honeycomb blanket structure of stainless steel supports breeder elements which contain lithium metasilicate and a beryllium neutron multiplier. These are cooled by helium at 50 bar. Tritium extraction is continuous; it diffuses from the breeder into the helium circuit and a small fraction of the total flow is processed in a molecular sieve system. A local breeding ration of about 1.26 is achieved together with a blanket coverage of 60%. For a self sufficient section 80% coverage would be required. Helium at 580°C raises steam at 500°C and 170 bar which is delivered to a 7MW(e) turbo-generator. No account was taken of the heat generated in the first wall and the divertor because these were the subjects of specialist study within the INTOR/NET project.

48970 **FELIX: Construction and testing of a facility to study electromagnetic effects for First Wall, Blanket, and Shield systems.** Praeg, W.F.; Biggs, J.; Knott, M.J.; Lari, R.J.; McGhee, D.G.; Turner, L.R.; Wehrle, R. (Argonne National Laboratory, Argonne, IL). pp 186-193 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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An experimental test facility for the study of electromagnetic effects in the FWBS systems of fusion reactors has been constructed over the past 2-1/2 years at Argonne National Laboratory (ANL). In a test volume of 0.76 m^3 a vertical pulsed 0.5 T dipole field ($B < 50$ T/s) is perpendicular to a 1 T solenoid field. Power supplies of 2.75 MW and 5.5 MW and a solid state switch rated 13 kV, 13.1 kA (170 MW) control the pulsed magnetic fields. The total stored energy in the coils is 2.13 MJ. The coils are designed for a future upgrade to 4 T for the solenoid and 1 T for the dipole field (a total of 23.7 MJ). This paper describes the design and construction features of the facility. These include the power supplies, the solid state switches, winding and impregnation of large dipole saddle coils, control of the magnetic forces, computer control of FELIX and of experimental data acquisition and analysis, and an initial experimental test setup to analyze the eddy current distribution in a flat disk.

48971 **Mechanical analysis of first wall tubes for the libra conceptual reactor.** Lovell, E.G.; Engelstad, R.L. (Fusion Engineering Program, Nuclear Engineering Department, University of Wisconsin, Madison, WI). pp 216-219 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The mechanical design of a first wall tube bank system for ICF reactor cavities is strongly influenced by parametric results of dynamic response analyses. Under sequential lateral pressure pulses, transient startup motion of tubes is followed by steady state oscillations of a frequency corresponding to the reactor repetition rate. It is shown that the steadystate amplitude and the corresponding alternating amplitude are sensitive to the repetition rate, tensile preload and internal liquid metal flow velocity.

48972 **Fusion blanket high-temperature heat transfer.** Fillo, J.A. (Brookhaven National Laboratory, Upton, NY). pp 199-205 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Deep penetration of 14 MeV neutrons makes two temperature region blankets feasible. A relatively low temperature (about 300°C) metallic structure is the vacuum/coolant pressure boundary, while the interior of the blanket, which is a simple packed bed of nonstructural material, operates at very high temperatures ($>$1000°C). The water-cooled shell structure is thermally insulated from the steam-cooled interior. High temperature steam can dramatically increase the efficiency of electric power generation, as well as produce hydrogen and oxygen-based synthetic fuels at high-efficiency.

48973 **Vaporized wall material/plasma interaction during plasma disruption.** Merrill, B.J.; Carroll, M.C.; Jardin, S.C. (EG & G Idaho, Inc., Idaho Falls, ID). pp 1291-1296 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The purpose of this paper is to discuss a new plasma disruption model that has been developed for analyzing the consequences to the limiter/first wall structures. This model accounts for: nonequilibrium surface vaporization for the ablating structure, nonequilibrium ionization of and radiation emitted from the ablated material in the plasma, plasma particle and energy transport, and plasma electromagnetic field evolution during the disruption event. Calculations were performed for a 5 ms disruption on a stainless steel flat limiter as part of a D-shaped first wall. These results indicated that the effectiveness of the ablated wall material to shield the exposed structure is greater than predicted by earlier models, and that the rate of redeposition of the ablated wall material ions is very dramatic. Impurity transport along magnetic field lines, global plasma motion, and radiation transport in an optically thick plasma are important factors that require additional modeling. Experimental measurements are needed to verify these models.

48974 **Solid breeder test blanket in TASKA-M.** Malany, S.; Weinberg, D. (Institut fur Reaktorbau Elemente, Kernforschungzentrum Karlsruhe, Karlsruhe 1). pp 1180-1185 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The solid breeder test blanket described in this paper is one of the four test modules of TASKA-M an optimized tandem mirror device for fusion technology tests. The space available for the solid breeder test blanket is a 0.43 m long and 0.15 m thick annulus. A decision has been made to design this blanket as a test bed for all kinds of breeding materials rather than as a blanket with a high breeding gain. Main emphasis has been placed on fast, easy insertion and with drawal of the irradiation samples. This is accomplished by using a breeding ball blanket concept where the Li-ceramic is contained in spherical SS shells. The balls are filled into pressure tubes coiled up around the plasma. The exchange of the balls can be done during operation without any disassembling of the modul. The tritium extraction can easily be done by heating the balls up to 800°C in a special recovery system outside the reactor.

48975 **Neutronics and photonics of a tritium and HE-3 Breeding Pellet.** Rayheb, M.; Haseltine, D. (University of Illinois, Nuclear Engineering Program, Urbana, Illinois). pp 1171-1178 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The neutronics and photonics performance of a pellet with a small D-T core spark trigger, surrounded by a large volume of D to enable tritium and He-3 breeding, is examined. The response to a 70 percent DD with 30 percent DT composite neutron spectrum is calculated using either W, Be or Pb as structural materials at core density-radius products ranging from 9.42 to 94.2 kg/m^2 At a core density-radius product of 94.2, the DT neutron source leads to an excess particle multiplication of 0.43 neutrons per source neutron. The percentage of energy leakage from the pellet in the form of escaped neutrons is 42.3 percent of the source energy for the DT source, and 28.8 percent for the DD source. The gamma-ray energy percentage deposited in the pellet is 26.7 percent for the DT source and 106.6 percent for the DD source. For the pellet with the composite source, the energy multiplication factor is 1.27. Thus the large DD contribution to the composite neutron source results in the pellet performing many of the functions normally reserved for the blanket such as spectral softening, breeding, and neutron and energy multiplication. The neutron energy leakage is 38.4 percent of the source energy for the composite source. It is estimated that the neutron energy leakage amounts to 10.6 percent of the fusion energy, compared with 70 percent as neutron energy in a DT pellet. When incorporated into a conceptual power reactor design, the characteristics of such a pellet design are shown to potentially lead to systems with higher power densities, reduced radiation damage of the first structural wall, and lower risks of tritium leakage under operational and accident conditions.

48976 **Large scale production of lithium oxide pellets and breeder rods for the TFTR Lithium Blanket Module.** Graumann, D.W.; Lindgreen, J.R.; Yang, L. (GA Technologie Inc., San Diego, CA). pp 1158-1165 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The processes and procedures for large scale fabrication of the Li_2O pellets and breeder rod assemblies for the TFTR Lithium Blanket Module (LBM) have been developed. The equipment necessary to produce 25,000+ pellets over a relatively short time period was selected. Operation of the automatic pellet press and the programmable cycle vacuum sintering furnace was demonstrated, and large quantities of pellets were produced. The powder particle size distribution has been selected and a Li_2O powder product specification written. Large-scale pressing and sintering procedures have been developed, quality control activities are well defined, and health and safety guidelines are established. Development breeder rods have been built and tested. The mass-production rod assembly equipment was selected and set up, and rod manufacturing procedures were defined.

48977 **Ion-beam system for tritium permeation experiments.** Andrel, R.A.; Holland, D.F. (EG & G Idaho, Inc., Idaho Falls, ID). pp 1153-1157 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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An experimental facility has been developed to carry out permeation experiments for candidate first-wall materials subjected to high fluxes of energetic hydrogen isotope ions. The experimental facility consists of (a) an ion-beam system for production of intense, mass-analyzed ion beams with energies variable from 500 eV to 10 keV, (b) a target chamber system for directing an ion beam onto a heated target and for measuring various implantation-related experimental parameters, and (c) a downstream system for measuring the implanted gas which permeates the specimen. The target chamber and downstream system are equipped with diagnostic capabilities to permit simultaneous measurement of the permeation, reemission, and sputtering effects for target materials. Operational tests with the system have yielded hydrogen and deuterium ion-beam intensities from 0.4 x 10^{15} ions/cm^2-s at 0.8 keV to greater than 3.0 x 10^{15} ions/cm^2-s at 9.6 keV. Baseline pressures as low as 7 x 10^{-6} Pa, 0.7 x 10^{-6} Pa, and 3 x 10^{-6} Pa have been achieved in the accelerator, target chamber, and downstream systems, respectively. Target temperatures in excess of 500°C have been achieved with the target heater assembly. Experiments will be conducted to investigate reemission and permeation for various stainless steels and vanadium alloys implanted with deuterium ion beams. The facility will then be converted to tritium operation for engineering tests of first-wall structures.

48978 **Fusion blanket design fundamentals.** Bertone, P.C.; Kasturirangan, T.M. (Dept. of Chem Eng., Princeton Univ., Princeton, NJ). pp 1148-1152 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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This paper presents a general model of a fusion power plant based on simple tritium material balances. The major tritium systems and tritium flows are identified, and fundamental relationships between the system variables are developed. It is shown how the model can be used to develop relationships between important design parameters such as the doubling time, the tritium inventory, the breeding ratio and the tritium burn rate. As an example, doubling times for the PRD, UWMAK II, SOLASE, and STARFIRE designs are calculated. Finally, the model is used to identify the major disadvantages of a breeder rod blanket design, and to identify a related blanket concept which seems promising.

48979 **Thermal-hydraulic testing of fusion reactor first wall concepts.** Easoz, J.R. (Westinghouse Electric Corp - Advanced Energy Systems Div, Madison, PA). pp 1107-1112 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A series of experiments have been carried out at the ESURF facility for the purpose of examining the thermal hydraulic characteristics of two fusion reactor first wall concepts. The test specimens were fabricated of Type 316 stainless steel, one being a tube of 27.8 mm outside diameter and 4 mm wall thickness. The second specimen consisted of a flat plate with five internal parallel coolant channels of rectangular (12.7 mm x 19.0 mm) cross section. The second specimen also had a 4 mm wall thickness (heated surface to coolant channel). The experiments characterized the non-boiling thermal performance of the plate specimen under single sided surface heat fluxes up to 1.0 MW/m^2. In addition, the phenomena of the onset of nucleate boiling and departure from nucleate boiling were observed and characterized for this asymmetrically heated configuration at higher surface heat flux loadings.

48980 **Thermal shock considerations for the TFCX limiter and first wall.** Haines, J.R.; Fuller, G.M. (Fusion Engineering Design Center/McDonnell Douglas Astronautics Company, Oak Ridge National Laboratory, Oak Ridge, Tennessee). pp 1113-1116 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Resistance to thermal shock fracture of limiter and first-wall surface material candidates during plasma disruption heating conditions is evaluated. A simple, figure-of-merit thermal shock parameter that provides a means of ranking candidate materials is derived. Combining this figure-of-merit parameter with parameters defining specific heating conditions yields a nondimensional thermal shock parameter. If this parameter is below a critical value, a given material is expected to undergo thermal shock damage. Prediction of thermal shock damage with this parameter is shown to exhibit good agreement with test data. All materials examined in this study with the critical parameter value approach are expected to be damaged by thermal shock for nominal TFCX plasma disruption conditions. Since the extent of this damage is not clear, tests that explore the range of expected conditions for TFCX are recommended.

48981 **Thermal contact conductance measurements on Doublet III armor tile graphite.** Doll, D.W.; Reis, E. (GA Technologies Inc., San Diego, CA). pp 1099-1102 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Several tests were performed on the Doublet III wall armor tiles to determine the cool-down rate and to evaluate improvements made by changing the conditions at the interface between the graphite tile and the stainless steel backing plate. Thermal diffusivity tests were performed in vacuum on both TiC coated and bare graphite tiles with and without 0.13 mm (.005") thick silver foil at the interface. The results of the armor tile cool-down tests showed improvement when a 0.13 mm (0.005") silver foil is used at the interface. At 2.1 x 10^5 Pa (30 psi) contact pressure, the e-folding cool-down times for a TiC coated tile, bare graphite and bare graphite with a 0.06 mm (0.0035") silver shim were 10 min., 5.0 min., and 4.1 min., respectively. Tests using high contact pressures showed that the cool-down rates converged to about 4.0 min. At this limit, the conduction path along the backing plate to the two cooling tubes controls the heat flow, and no further improvement could be expected. Thermal diffusivity measurements confirmed the results of the cool-down test showing that by introducing a silver foil at the interface, the contact conductance between Poco AXF-5Q graphite and 316 stainless steel could be improved by a factor of three to eight. The tests showed an increasing improvement over a range of temperatures from 25°C to 400°C. The data provides a technical basis for further applications of graphite tiles to cooled backing plates.

48982 **Performance and failure mode of generic beam dump panels.** Blewer, R.S.; Whitley, J.B. (Sandia National Laboratories, Albuquerque, NM). pp 1027-1030 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The design of beam and plasma dumps is predicated on the successful development of actively cooled panels or tube banks that can withstand heat fluxes of several kilowatts per square centimeter for thousands of multisecond cycles. As part of a high heat flux component development program, analysis of several types of advanced high heat flux targets after exposure to a high heat flux environment was performed using metallographic analysis, scanning electron microscopy and electron microprobe analysis. Sample failure was attributed to several different mechanisms in different tests, and included surface melting, water deposit buildup, coating/substrate interaction and internal erosion.

48983 **First wall and limiter lifetime in pulsed tokamak reactors.** Ehst, D.A.; Cha, Y.; Hassanein, A.; Majumdar, S. (Argonne National Laboratory, Argonne, IL). pp 1038-1042 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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This study concentrates on the structural integrity of certain reactor subsystems under cyclic operation to answer the question: "How long a burn pulse is needed to achieve the benefits of steady-state operation"? Component lifetime in the steady-state is limited by three effects: radiation damage, disruptions, and sputtering erosion. Cyclic operation modifies one of these (the number of disruptions may increase with the number of burn cycles) and introduces a fourth life limit, thermal fatigue. The design strategy is to determine the structure and coating thicknesses which maximize component lifetime against all life limitations. After calculating disruption damage (vaporization, melting) for candidate materials the authors present the lifetime analysis for different structures.

48984 **Evaluation of operation region of JT-60 first wall related to high heat flux.** Nakamura, H.; Masuda, M.; Shimizu, M.; Shimizu, T. (Japan Atomic Energy Research Inst). pp 1022-1026 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Maximum operation region of JT-60 first wall was evaluated from a viewpoint of thermostructural analysis. As a design criterion, ASME SECTION-III is used. By reducing heat flux due to 71% remote cooling and + or - 3.5 cm swing of separatrix magnetic surface, present design of magnetic limiter plate allows a discharge of 10 sec duration, 10 min interval time, and 30 MW heating. In the case of NB armor plate, 104 about 174 W/cm^2 (3 about 5% penetration of NB) is permitted. In the same way, in the case of toroidal fixed limiter, 300 about 450 W/cm^2 is permitted.

48985 **Disruption heat load simulations using electron beams.** Easoz, J.R.; Bajaj, R.; Gould, R.E. (Westinghouse Electric Corp. - Advanced Energy Systems Division, Madison, PA). pp 1008-1013 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Results of work performed under Program Element I (PE-I) of the First Wall, Blanket, and Shield Engineering Technology Program are reported. Technical coordination has been provided by the Argonne National Laboratory Management and Technical Coordination Center (MTCC). The principal objectives of this program element are the testing of first wall design concepts to support the design of fusion reactor first walls and the verification of analytical techniques and design tools. The test results were generated using the ESURF (Electron Beam Surface Heating Facility) installation at the Westinghouse Research and Development Center. The ESURF facility consists of a 36 kW continuous duty electron beam, evacuated target chamber, and a 6.9 MPa water loop. The objective of the reported experiments was to provide melt thickness data as a function of energy density and pulse duration for comparison with published computer analyses of disruption heat load effects.

48986 **Preconceptual design and analysis of a solid-breeder blanket test in an existing fission reactor.** Deis, G.A.; Hsu, P.Y.; Watts, K.D. (EG & G Idaho, Inc., Idaho Falls, ID). pp 468-471 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Preconceptual design and analysis have been performed to examine the capabilities of a proposed fission-based test of a water-cooled Li_2O blanket concept. The mechanical configuration of the test piece is designed to simulate a unit cell of a breederoutside-tube concept. This test piece will be placed in a fission test reactor, which provides an environment similar to that in a fusion reactor. The neutron/gamma flux from the reactor produces prototypical power density, tritium production rates, and operating temperatures and stresses. Steady-state tritium recovery from the test piece can be attained in short-duration (5-to-6-day) tests. The capabilities of this test indicate that fission-based testing can provide important near-term engineering information to support the development of fusion technology.

48987 **The tandem mirror experiment upgrade (TMX-U) diagnostics data system.** Clauser, J.F.; Parrish, C.P. (Lawrence Livermore National Laboratory, Livermore, CA). pp 1989 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The diagnostics data system on the TMX-U experiment is a general purpose system for handling acquisition, processing, archiving, interactive selection and retrieval, and graphical and tabular outputting of data for pulsed controlled thermonuclear reaction experiments. It routinely acquires and processes three MBytes of data per shot at an average shot rate of one per 8 minutes. The computer hardware consists of five CPUs in a star configuration with approximately 500 MBytes of disk storage at the central node, upon which all CPUs may read and write. The use of several CPUs in parallel increases computing power, while the use of eight disk drives in parallel increases disk speed. All processing, outputting, and acquisition are performed by program modules that allow chained operations, i.e., the inputs for a given task (program execution) are the output(s) of a previous task or tasks. Inputs may be any data-set on disk. Tasks for various shots may overlap so that high priority results are immediately available, while low priority results may backlog and catch up during lulls in experiment operation. Task selection is thus both data-availability and priority driven. It is done in a distributed fashion, independently by each of the five CPUs (not master-slave). A given task will run on any available, suitable CPU. CPU suitability is determined using a device resource control system. Program resource requirements, task definitions, task lists, etc., as well as permanent definitions of all archived data-set configurations and symbols are saved using a commercial data-base system and custom editor, which form a data-system "notebook". The actual data are held in a custom data base with a hybrid relational/hierarchical form. Data-set formats are selectable from a rich, yet standardized set that can accommodate a large variety of acquired or calculated data.

48988 **The magnet power control system for the tandem mirror experiment-upgrade.** Bell, H.H. (Lawrence Livermore Nat. Lab., Livermore, CA). pp 1980-1983 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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This paper describes the desktop computer/CAMAC based system that controls the power source for the Tandem Mirror Experiment-Upgrade (TMX-U) magnet power system. Presently it contains 42 dc rectifier power supplies connected to 24 magnet coils arranged in 17 circuits. During each shot, the system delivers 22.6 MW dc to the magnets for about 3 s. The system is presently being changed to add six power supplies, two solenoidal throttle coils, and two reverse C-coils. When complete, the delivered power will increase to 36.9 MW. The closed-loop control system usually provides current (and thus, magnetic field) that is within 1% of the requested current. Achieving this accuracy required using grounding, shielding, and isolation methods to reduce noise and related problems.

48989 **The gas box control system for the tandem mirror experiment-upgrade.** Bell, H.H.; Clover, C.A.; Hunt, A.L. (Lawrence Livermore Nat. Laboratory, Livermore, CA). pp 1977-1979 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The Tandem Mirror Experiment-Upgrade (TMX-U) uses several methods to feed gas (usually deuterium) at different energies into the plasma region of the machine. One is an arrangement of eight high-speed piezo-electric valves mounted on special manifolds (gas box) that feed cold gas directly to the plasma. This paper describes the electronic valve control and data acquisition portions of the gas box, which are controlled by a desk-top computer. Various flow profiles have been developed and stored in the control computer for ready access by the operator. The system uses two modes of operation, one that exercises and characterizes the valves and one that operates the valves with the rest of the experiment. Both the valve control signals and the pressure transducers data are recorded on the diagnostics computer so that they are available for experiment analysis.

48990 **Magnetic forces on plate conductors in a varying high magnetic field.** Leftheris, B.; Hay, A.D. (Grumman Aerospace Co., Bethpage, NY). pp 1520-1525 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The structural support of detectors, actuators and shielding for diagnostic equipment used with the Tokamak Fusion Test Reactor (TFTR) must be designed so that it is compatable with its environment, which contains powerful magnetic fields. Some fields change very rapidly while others remain steady. The designer must recognize the effect of these fields on the structure. The structure must withstand the magnetic forces, and the magnetic fields generated in the structure must not reflect back upon the carefully shaped Toroidal Field causing an unacceptable perturbation. The case of a flat plate mounted in an area having a steady tangential (toroidal) and varying vertical (poloidal) magnetic field is examined. Larger structures are composed of such small elements. The method described in this paper is not a rigorous analysis of the subject of interaction of magnetic fields with structures. Instead it is a quick way to estimate the forces and moments in structures using a small calculator. For bigger more involved problems, see report PPPL 1517, "Transient Eddy Currents on Finite Plane and Toroidal Conducting Surfaces", by D.W. Weissenburger and V.R. Christensen and report PPPL-1516, "Time Varying Eddy Currents on a Conducting Surface in 3-D Using a Network Mesh Method", by V.R. Christensen.

48991 **Electrical design of a high current density air-core reversed-field pinch "ZTP".** Reass, W.A.; Cribble, R.F.; Melton, J.G. (Los Alamos National Laboratory, Los Alamos, New Mexico). pp 1512-1515 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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This paper describes the electrical design of a small, high current density (10 MA/m²) toroidal reversed-field Z-Pinch (RFP) presently being constructed at Los Alamos. Special purpose magnetic field programs were used to calculate self and mutual inductances for the poloidal field windings. The network analysis program MINI-SCEPTRE was then used to predict plasma current, including the interaction between toroidal and poloidal field circuits, as described by the Bessel function model for RFP's. Using these programs, coil geometry was obtained for minimal field errors and the pulse power systems were optimized to minimize equilibrium control power. Results of computer modeling and implementation of the electrical circuits are presented.

48992 **Design and verification tests for a 20-MJ pulsed poloidal coil.** Shimamoto, S.; Ando, T.; Hattori, Y.; Hiyma, T.; Nishi, M.; Okuno, K.; Tada, E.; Takahashi, R.; Takahashi, Y.; Tsuji, M. (Japan Atomic Energy Research Inst.). pp 1358-1361 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Three designs for a 20-MJ pulsed poloidal coil, using three kinds of pulsed conductors, are compared with each other. These conductors, already developed by JAERI, are two pool-cooled 50-kA pulsed conductors and a 30-kA cable-in-conduit conductor. The results of comparison indicated that the forced-cooled coil has less mechanical stress and pulsed loss than poolcooled ones, although pool-cooled coils have much higher thermodynamical reliability. In addition to design comparison, some results of verification tests on these pulsed conductors are described.

48993 **Magnetic shielding tests for MFTF-B neutral beamlines.** Kerns, J.; Fabyan, J.; Koger, R.; Wood, R. (Lawrence Livermore Nat. Laboratory, Univ. of California, Livermore, CA). pp 1421-1425 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A test program to determine the effectiveness of various magnetic shielding designs for MFTF-B beamlines was established at Lawrence Livermore National Laboratory (LLNL). The proposed one-tenth-scale shielding design models were tested in a uniform field produced by a Helmholtz coil pair. A similar technique was used for the MFTF source-injector assemblies, and the model test results were confirmed during the Technology Demonstration in 1982. The results of these tests on shielding designs for MFTF-B had an impact on the beamline design for MFTF-B. The iron-core magnet and finger assembly originally proposed were replaced by a simple, air-core, race track-coil, bending magnet. Only the source injector needs to be magnetically shielded from the fields of approximately 400 gauss.

48994 **Magnetic shielding design analysis.** Kerns, J.; Deplapaz, A.; Fabyan, J. (Lawrence Livermore National Laboratory, Univ. of California, Livermore, CA). pp 1416-1420 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Two passive magnetic-shielding-design approaches for static external fields are reviewed. The first approach uses the shielding solutions for spheres and cylinders while the second approach requires solving Maxwell's equations. Experimental data taken at LLNL are compared with the results from these shieldings-design methods, and improvements are recommended for the second method. Design consideration are discussed here along with the importance of material gaps in the shield.

48995 **Performance analysis of 180° reflection magnet in Doublet III neutral beamline.** Hong, R.; Colleraine, A.P.; Kamperschroer, J.H.; Kim, J.; Treglio, J.R. (GA Technologies Inc., San Diego, CA). pp 1465-1468 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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In this paper, the authors examine the beam power transmission and deposition in the bending magnet region of the Doublet III neutral injection beamline. Two effects are investigated: the change in power transmitted through the magnet with the calorimeter in and out of the beamline, and the lack of ion power returning to the ion dump. It is shown that gas evolving and reflecting from the calorimeter raises the gas pressure in the magnet gap to produce charge exchange losses resulting in about 13% decrease in neutral beam power passing through the gap. It has also been determined that the missing ion power is deposited on the magnet pole piece shields. The design and operation of the bending magnet is described in Section 2. In Section 3 they discuss the missing neutral power caused by charge exchange losses. In Section 4, they compare the experimental data with that calculated using two Monte Carlo computer codes, TRAN3D and REION, and conclude with an examination of an accident which resulted in the melting of copper louvers bordering the magnet gap.

48996 **Instrumentation signal conditioning for the Large Coil Test Facility.** Murphy, J.L. (Oak Ridge National Laboratory, Oak Ridge, TN). pp 1915 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Signal conditioning for the LCTF sensors varied with sensor types. The sensors are divided into two areas: coil diagnostics, and facility. The types of sensors used on each of the test coils, and on the facility, are similar; the main difference is the signal conditioning for each. Five types of signals are conditioned: coil voltages, temperature, strain, displacement, and magnetic fields. Voltage tap signal conditioning will provide two functions: coil diagnostics, to determine the cryostability limits, and coil protection by monitoring the IR level of the coil conductor. The signal conditioning will provide high voltage isolation, filtering, analog subtraction of the di/dt signals, detection of a normal zone, and outputs for coil protection. Temperature sensors consist of the resistance type and type E thermocouples. Signal conditioning provides for high voltage isolation, with constant current sources. The thermocouple signals are conditioned through an analog signal scanner system. Strain gages with dummy temperature compensating gages are installed on the coil and supporting structures. An ac carrier system allows for more accurate measurements. A dc excitation system provides for gages that are not at critical locations. Displacements are monitored by either a full bridge strain gage or a moving slug displacement transducer (MSDT). The full bridge strain system is conditioned through a standard strain gage scanner, while the MSDT sensor is excited by a 2 megahertz oscillator/demodulator system. Magnetic field measurements are made using hall probes, copper magnetic resistance probes, and pickup coils. Constant current sources provide the required stimulus. The detected analog signals are conditioned either by a high voltage isolation amplifier or by a low voltage A/D converter.

48997 **Design features of T-2, a torsatron reactor with continuous, demountable coils.** Potok, R.E.; Cohn, D.R.; Lidsky, L.M. (Massachusetts Institute of Technology, Cambridge, MA). pp 1859-1863 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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This paper describes the features of the continuous winding torsatron reactor T-2. The helical magnet system is comprised of modular units, with the coils connected through demountable, resistive joints at the module interfaces. Reactor maintenance can be performed through the access existing between the helical coils (without moving the coils). This design feature combines desirable features of both the continuous and modular coil concepts; the continuous current paths provide more vacuum rotational transform (¯/iota/) and reduce the out-of-plane forces on the coils, while the demountable joints allow for magnet maintenance and replacement. The blanket modules would be of moderate size (the blanket structure of the illustrative reactor design was divided into three sections for each of the 19 field periods, the sections weighing 500, 100, and 25 tonnes). Results indicate that the coil winding law can be optimized to produce adequate access and good flux surface quality.

48998 **Scaling of superconducting toroidal field coil costs and implications for tokamak reactor design.** Cooke, P.I.H. (Culham Laboratory, Abingdon, Oxon). pp 1839-1843 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A scaling rule to show how the cost of a superconducting toroidal field coil system for a future tokamak fusion reactor depends on the major parameters of the device is described. For values of toroidal field in the range of interest the cost scales approximately with the square of the peak field on the coil. The cost scaling is applied to a simple tokamak reactor cost model which suggests that the economic incentive to use high field, high wall loading reactors is reduced.

48999 **The first model of a shielded superconducting energy storage as a power supply for poloidal coils.** Shintomi, T.; Masuda, M. (National Laboratory for High Energy Physics). pp 1785-1787 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The pulsed superconducting magnetic energy storage with the concept of a shield coil was proposed as a power supply for the pulsed load of Tokamak fusion reactors. This system may be operated very stably because of no ac losses in a superconducting coil. As this pulsed superconducting magnetic energy storage can act as a reservoir for the pulsed load, a utility line is not affected by any harmful influence at its pulse operation. The effectiveness of the system was checked by a 200 kJ model coil and then it is confirmed that this system is sufficiently available for the power supply of the pulsed loads of Tokamak fusion reactors.

49000 **Control and protection of thyristor convertors for JT-60 poloidal field coils.** Ikeda, H.; Aoyagi, T.; Matsukawa, M.; Nakayawa, S.; Shimada, R.; Ujiie, K.; Yamayishi, T. (Toshiba, Tokyo). pp 1764-1769 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The JT-60 poloidal field power supply (PF-power supply) consists of high-voltage and high-current thyristor convertors. High accuracy, quick response and high reliability are the requirements for the PF-power supply. The new control methods and new protective interlocks were developed for the JT-60 PF power supply. This paper describes the function and the test results regarding the following three items. 1. Configuration of a DDC (direct digital control) and a non-interactive control algorithm. 2. Digital phase control circuit. 3. New protective interlock called GATE ADVANCE.

49001 **Advantages of the distributed structure concept of the Westinghouse LCP coil design.** Singh, S.K.S.; Gaberson, P.C.; Hordubay, T.D.; Young, J.L. (Westinghouse Electric Corporation, East Pittsburgh, PA). pp 1752-1755 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The forced flow Nb_3Sn magnet concept developed by Westinghouse, under subcontract to Union Carbide Corp., offers the national fusion program the option of a reactor sized superconducting toroidal field coil which has the capability of achieving peak fields of 12 tesla. The Westinghouse/ORNL coil concept offers a number of advantages, besides high field capability. The coil is fabricated by winding stainless steel jacketed conductors into machined slots in the structural plates. This configuration provides positive conductor support and prevents accumulation of magnetic loading on individual conductors. In addition, this distribution of the conductors results in a more uniform current density in the overall coil cross-section and provides higher field on the plasma axis for a given peak field at the conductor. The distributed structure concept provides uniform distribution of eddy current losses and has lower AC losses than lumped structure concepts. In addition, the modular construction addresses the maintainability and repairability issues associated with a commercial reactor. The higher current densities, due to more efficient utilization of space, could lead to reduced reactor size which in turn would provide substantial cost advantage.

49002 **Stabilization and cooling requirements for the alcator DCT superconducting magnet system.** Schultz, J.H.; Brindza, P.D.; Hoenig, D.B.; Montgomery, D.B. pp 1747-1751 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Alcator DCT, an experimental tokamak to be constructed at M.I.T., will be the first tokamak in the world with entirely superconducting magnets. The combined objectives of the toroidal field (TF) and poloidal field (PF) magnets are ambitious and prototypical of reactor-scale magnets, such as those considered for the Toroidal Fusion Core Experiment (TFCX). The superconducting magnets must carry currents up to 23 kA, with maximum terminal voltages of 20 kV, and should not be driven normal by disruptions, following an initiation blip and plasma start-up. The cryogenic load is dominated by current lead losses and pulsed field losses, and also includes joint, thermal radiation and cold mass support losses. The refrigerator load topology includes a naturally circulating twophase pool of helium for the TF coils and either that or forced-flow, single phase helium for the PF coil winding packs. Single phase helium is provided to the PF coil cold cases and liquid nitrogen to the outer vacuum dewar.

49003 **Design considerations for forced-flow superconductors in tokamak toroidal-field coils.** Materna, P.A. (Princeton Univ., Plasma Physics Laboratory, Princeton, NJ). pp 1741-1746 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Forced-flow superconductors, which are being considered for tokamak toroidal field coils, have thermal-hydraulic characteristics significantly different from those of pool-boiling conductors, and they have also been considered unsuited to current density grading. Here, a new winding pattern is described which is particularly useful for grading forced-flow conductors wound in double pancakes. Also, steady-state thermal analysis is presented for forced-flow conductors subjected to nuclear heating typical of a toroidal field coil of a large ignition tokamak. In some instances the temperature rise is excessive, but design changes are possible which limit the temperature rise to a reasonable amount.

49004 **TFCX-S toroidal field coil design using a superfluid helium-cooled winding.** Kalasi, S.S.; Coffman, L.; Hooper, R.J. (Oak Ridge National Laboratory, Oak Ridge, TN). pp 1736-1740 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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This paper discusses the design and performance of the toroidal field (TF) coils for one of the possible options for the Tokamak Fusion Core Experiment (TFCX). TFCX is a proposed long-pulse, ignited, "next step" tokamak to follow the Tokamak Fusion Test Reactor (TFTR). In the TFCX option considered here (designated TFCX-S), there are 16 superconducting TF coils that produce 4.3 T at a plasma major radius of 3.75 m. Each of the TF coils is rated at 5.06 MA-turns, and operates at a peak field of 9.8 T at the winding. Several winding/cooling approaches have been considered for the TFCX-S TF coils. A NbTi winding, cooled by superfluid helium (He-II at 1.8 K), is discussed here. The conductor is similar to that being developed by GA Technologies, Inc., as part of the Department of Energy (DOE) 12-T conductor development program. Use of either subcooled atmospheric pressure He-II or saturated subatmospheric pressure He-II has been considered; both cooling schemes appear feasible. The winding is designed to be cryostable. The coil can recover from a half-turn-normal condition by the cold end-recovery mechanism. The winding can be safely discharged using a peak dump voltage of 1000 V. The peak permissible heating rate (at the high field conductor) is estimated to be 5 mW/cm^3, which is a limiting restraint in setting the shield thickness in this design. A lower shield thickness would lead to a lower overall device capital cost (despite the increased refrigeration expense), but it would result in a higher peak heating rate that is unacceptable from a standpoint of heat removal capability.

49005 The application of He-II technology to the production of ultrahigh-field superconducting magnets. Hoard, R. (Lawrence Livermore National Laboratory, Livermore, CA). pp 1731-1735 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Data and operating experience acquired during the last three years on the heat-transfer properties of pressurized superfluid He II indicate that the fluid can be successfully used as a coil coolant for high-field superconducting magnets. Indeed, the fluid seems to offer triple benefits over that of ordinary normal LHe: 1) coil conductors can be driven to wetted perimeter heat fluxes exceeding 1 W . cm^{-2}; 2) the reduced low-temperature operation (from 4.2) at 1.8 K enhances the critical current densities (J /SUB c/) of both Nb_3Sn and ternary additions to the compound by 140 to 200 percent; 3) the upper critical field (H /SUB c2/) also increases, allowing viable solenoid magnet designs approaching 20-T peak fields. This paper reviews the significant properties of He II relevant to magnet design, describes current superconducting coils and systems that utilize the fluid, and discusses the possible application of the present data base to production of future ultrahigh-field superconducting coils yielding 20-T fields.

49006 Fundamentals of He II and its application to superconducting magnet systems. Vansciver, S.W. (Applied Superconductivity Center, University of Wisconsin-Madison, Madison, WI). pp 1727-1730 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The present paper surveys the current understanding of He II as applied to large magnet systems. Topics discussed include: steady state and transient heat transport, forced convection, and surface heat transfer. Recent experimental research and analysis are reviewed. Application of He II to large superconducting devices is also discussed. Emphasis is placed on understanding the stability of composite conductors cooled by He II.

49007 Recent operating history and current axisymmetric coil additions to tandem mirror experiment upgrade. Chargin, A.K.; Calderon, M.O.; Moore, T.L. (Lawrence Livermore Nat. Laboratory, Livermore, CA). pp 2113 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Since the end of construction in December 1981, the authors have operated TMX-U through seven experimental runs. In the first two runs, they concentrated on making the hardware operational, conditioning the walls, and generating initial plasma. After that they proceeded through the planned experimental sequence: generating sloshing ions, developing electron cyclotron resonance heating (ECRH) start-up techniques, repeating conventional tandem results, producing hot electrons, modeling MFTF-B start-up, pumping cold ions from the end plug, and generating thermal barrier. These issues were studied in a series of seven runs, each lasting an average of four months. Typically each run consists of an at-air cycle lasting one month, a work-up period of one month, and two months of data taking. During the at-air time they configured the machine for the coming experiment and do the required maintenance. One of the current air cycles will involve a major reconfiguration of the machine. This reconfiguration consists of: a) installation of a high-field axisymmetric mirror (called throttle) at each end of the central cell, b) increasing the magnet power by 50%, c) adapting the vacuum envelope to the new coils, and d) making several smaller changes to other subsystems. The experimental goals of the new configuration are: a) to increase radial confinement time for central-cell ions, b) to investigate the trapped-particle instability, and c) to provide a facility for development of improved methods for pumping unwanted ions from potential barrier regions. All of the above experimental goals are accomplished by closely managed control of machine configuration, of costs, and of schedules.

49008 Technician support for operation and maintenance of large fusion experiments: the Tandem Mirror Experiment-Upgrade approach. Mattson, C.E. (Lawrence Livermore National Laboratory, Livermore, CA). pp 1690-1691 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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As experiments continue to grow in size and complexity, a few technicians will no longer be able to maintain and operate the complete experiment. Specialization is becoming the norm. Subsystems are becoming very large and complex, requiring a great deal of experience and training for technicians to become qualified maintenance/operation personnel. Formal in-house and off-site programs supplement on-the-job training to fulfill the qualification criteria. This paper presents the Tandem Mirror Experiment-Upgrade (TMX-U) approach to manpower staffing, some problems encountered, possible improvements, and safety considerations for the successful operation of a large experimental facility.

49009 Alternative power supply and dump resistor connections for similar, mutually coupled, superconducting coils. Owen, E.W.; Shimer, W.; Wang, S.T. (Lawrence Livermore National Laboratory, Livermore, CA). pp 2054-2058 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Alternative methods of connecting similar mutually coupled coils to their power supplies and dump resistors are investigated. The circuits are evaluated for both operating and fault conditions. The factors considered are the voltage to ground during a dump, short circuits, open circuits, quenches, and failure of the protection system to detect a quench. Of particular interest are the currents induced in coils that remain superconducting when one or more coils quench. The alternative connections include combined power supplies, individual dump resistors, combined resistors and series and parallel dump resistors. A new circuit that contains "coupling" resistors is proposed. The coupling resistors do not affect normal fast dumps but reduce the peak induced currents while also reducing the energy rating of the dump resistors. Another novel circuit, the series circuit with diodes, is discussed. The MFTF-B central-cell solenoids are used as an example.

49010 Protection of toroidal field coils using multiple circuits. Thome, R.J.; Langton, W.G.; Mann, W.R.; Pillsbury, R.D.; Tarrh, J.M. (Plasma Fusion Center, Massachusetts Institute of Technology, Cambridge, Massachusetts). pp 2059-2063 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The protection of toroidal field (TF) coils using multiple circuits is described. The discharge of a single-circuit TF system is given for purposes of definition. Two-circuit TF systems are analyzed and the results presented analytically and graphically. Induced currents, maximum discharge voltages, and discharge time constants are compared to the single-circuit system. Three-circuit TF systems are analyzed. In addition to induced currents, maximum discharge voltages, and time constants, several different discharge scenarios are included. The impacts of having discharge rates versus final maximum coil temperatures as requirements are examined. The out-of-plane forces which occur in the three-circuit system are analyzed using an approximate model. The analysis of multiplecircuit TF systems is briefly described and results for a Toroidal Fusion Core Experiment (TFCX) scale device are given based on computer analysis. The advantages and disadvantages of using multiple-circuit systems are summarized and discussed. The primary disadvantages of multiple circuits are the increased circuit complexity and potential for out-of-plane forces. These are offset by the substantial reduction in maximum discharge voltages, as well as other design options which become available when using multiple circuits.

49011 **Detection of minute stress changes in superconducting windings with piezoelectric sensors.** Ishigohka, T.; Iwasa, Y.; Tsukamoto, O. (Francis Bitter Nat. Magnet Lab.). pp 2064 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Stress-induced shifts in a resonant frequency of a superconducting magnet have been used to monitor changes in stress distribution in the magnet winding. Two piezoelectric elements are attached to the magnet; one to subject the magnet to vibration over a frequency range of 250 about 260 kHz and the other to receive the magnet's mechanical response. Localized changes in stress in the winding, induced by changes either in temperature or in electromagnetic force, shift the frequency spectrum of the response signal; by observing this shift one can monitor minute deviations in stress levels in the winding. The sensitivity of the technique is such that a localized temperature rise of about 1 K at 4.2 K is detectable.

49012 **Current sensing in magnetic fusion experiments by faraday rotation in single-mode optical fibers.** Chandler, G.I.; Jahoda, F.C. (Los Alamos National Laboratory, Los Alamos, NM). pp 2084-2090 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Interest in measurement devices which use optical fibers as the sensing element has increased rapidly in the last few years. Fibers interact with their environments in a number of useful ways. Most sensors developed so far have coupled the fiber mechanically to a transducer element which strains the fiber in response to an external field; the strain is measured interferometrically. Applications of this method include acoustic and field sensors. A second important class of sensors exploits the elasto-, electro-, and magnetooptic properties of the fiber material to directly sense the relevant fields. The sensors we report here are of this type. Essentially all of the sensor work uses single-mode fiber; in the beginning fiber intended for telecommunications applications was used but several companies now supply single-mode fiber optimized in various ways for sensors. Exploitation of the Faraday effect in glass fibers for the measurement of current was reported by Smith, Papp and Harms, and others. The authors became interested in using this technique on CTR magnetic fusion experiments because the unique dielectric properties of optical fibers hold promise for making possible the measurement of magnetic fields and currents where present techniques could not, and for avoiding some of the problems associated with the Rogowski coil-integrator system widely used now. Some experiments, the difficulties encountered, and the prospect for continued development of this diagnostic technique are reported.

49013 **Design description of the helical field coils for the advanced toroidal facility.** Cole, M.J.; Jernigan, T.C.; Johnson, R.L.; Nelson, B.E.; Thompson, P.B.; Vinyard, L.M.; Williamson, D.E. (Oak Ridge National Laboratory, Oak Ridge, TN). pp 876-879 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The Helical Field (HF) Coils for the Advanced Toroidal Facility will consist of two coils, which wrap around the plasma six times. The major radius of the coils will be 2.1 m with a minor radius of 45.75 cm to the coil current center. The coils will be positioned at assembly to within a 2 mm diameter around the winding law, Theta = 1/6 Phi. The coils will be fabricated as a set of 24 identical segments, 12 upper segments and 12 lower segments. These segments will be joined into continuous coils at the installation site by means of field assembled joints at the horizontal centerline of the machine. One special joint on each coil will contain the coil leads. The HF coils will consist of 14 copper turns and a structural member of stainless steel which has a cross section in the shape of a "T". These pieces will be fabricated in accordance with the winding law Theta = 1/6 Phi. The copper turns will be water cooled and formed from CDA 101 or 102 copper. The 14 copper turns will be positioned such that 7 turns will be placed on each side of the structural tee. The structural tee will be fabricated from 44.45 mm thick stainless steel with a minimum yield strength of 205 MPa and a tensile strength of 485 MPa.

49014 **Qualification of large superconducting magnets for fusion systems.** Montgomery, D.B. (Plasma Fusion Center, Massachusetts Institute of Technology, Cambridge, Massachusetts). pp 871-875 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Future project managers of large fusion systems using superconducting magnets, will require at a minimum: (1) that the magnet performance be sufficiently predictable to avoid the need for an unreasonable margin to cover uncertainty; (2) that the manufacturing technology for the superconducting system be developed to the point where costs are predictable; and (3) that a reasonable strategy exist for confirming, prior to assembly, that individual components meet specifications which will give reasonable assurance of long term machine performance. The authors define "qualification" of superconducting magnets as the ability of the magnet community to deliver these requirements. A qualification program to meet the project manager's requirements must maximize use of the existing data base (for example, LCP), concentrate on those apprpaches most likely to lead to predictable performance and fabrication maturity, and prove out an adequate component test strategy. A project oriented view is used to suggest a magnet qualification program for the next large step in the tokamak program, TFCX, which includes an intermediate scale device called Alcator DCT.

49015 **Structural analysis of the large coil test facility two-coil test.** Gray, W.H. (Oak Ridge, National Laboratory, Oak Ridge, TN). pp 880 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The Large Coil Test Facility (LCTF) test stand structural analysis involves the mechanical modeling of several different superconducting toroidal field magnets coupled with the calculation of a variety of thermal, mechanical, and magnetic loading conditions. The calculations presented in this report apply to the two-coil test of both the General Dynamics and JAERI large coils. Special attention is given to the mechanical interface of the LCTF with each participant coil and to locations on the LCTF where strain gage and displacement transducer instrumentation is located. The mechanical response of LCP is predicted at these important locations for the proposed two-coil test sequence. Further, a comparison is presented between the LCP design specification interface loads and displacements for the alternate B loading condition and a similar loading condition of the two-coil test. These considerations plus the practical problems encountered during the LCTF test stand large-scale analysis are addressed.

49016 **Review of MFTF yin-yang magnet displacement and magnetic field measurements and calculations.** Hanson, C.L.; Myall, J.O.; Wohlwend, J.W. (Lawrence Livermore Nat. Lab., Univ. of California, Livermore, CA). pp 881-885 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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During the recent testing of the MFTF yin-yang magnet, measurements of coil position, structural case strain, and magnetic field were made to verify calculated values. Measurements to detect magnet movement were taken throughout cooldown and during the operation of the magnet. The magnetic field at the mirror points was measured by Hall-effect probes. The magnet position, structural case strain, and magntic field measurements indicated a reasonably close correlation with calculated values. Information obtained from the yin-yang test has been very useful in setting realistic mechanical alignment values for the new MFTF-B magnet system.

49017 **Stabilization of axisymmetric displacements in ALCATOR DCT.** Thome, R.J.; Langton, W.G.; Mann, W.R.; Montgomery, D.B.; Pillsbury, R.D.; Politzer, P.A.; Wolfe, S.M. (Plasma Fusion Center, Massachusetts Institute of Technology). pp 892-896 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The highly elongated plasmas (e > 1.5) associated with divertor operation in the ALCATOR DCT tokamak are subject to a strong axisymmetric instability. A combination of passive loops and active feedback coils are needed for control of vertical plasma position. The design of this coil system is underway using two techniques. First, simplified models are used which lead to generalized diagrams for evaluation of the relative effectiveness of different locations for active or passive elements. These plots and the associated methodology are generally applicable to tokamak design. At the second level, a more detailed model, incorporating the specific machine configuration and constraints, is used to study the optimal active coil and passive element characteristics.

49018 **Computer-based data acquisition system in the Large Coil Test Facility.** Gould, S.S.; Layman, L.R.; Million, D.L. (Instrumentation & Controls Division, Oak Ridge National Laboratory, Oak Ridge, TN). pp 905-909 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The utilization of computers for data acquisition and control is of paramount importance on large-scale fusion experiments because they feature the ability to acquire data from a large number of sensors at various sample rates and provide for flexible data interpretation, presentation, reduction, and analysis. In the Large Coil Test Facility (LCTF) a Digital Equipment Corporation (DEC) PDP-11/60 host computer with the DEC RSX-11M operating system coordinates the activities of five DEC LSI-11/23 front-end processors (FEPs) via direct memory access (DMA) communication links. This provides host control of scheduled data acquisition and FEP event-triggered data collection tasks. Four of the five FEPs have no operating system. The executable program image is down-line loaded from the host. This stand-alone software permits data acquisition rates of up to 1000 samples/second for 64 fast diagnostic channels.

49019 **EDDYTRAN program system for eddy current, electromagnetic force and structural analysis.** Kameari, A.; Nikura, S. (Mitsubishi Atomic Power Industries Inc., Tokyo). pp 46-50 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A computer program system (EDDYTRAN), which is applicable to torus structures of magnetic fusion devices, has been developed to calculate the eddy current, electromagnetic force and structural analysis. The program system is designed to perform the following functions sequentially: 1) generation of model mesh and other data such as electromagnetic and mechanical properties of finite elements and boundary conditions, 2) calculations of eddy currents and electromagnetic forces, 3) transformation of the resultant force to load data fit to the structural analysis program, 4) structural analysis and 5) post-processing of the results. The EDDYTRAN utilizes the EDDYCUFF (EDDY CUrrent, magnetic Field and electromagnetic Force) program and the NASTRAN (NASA STRuctural ANalysis) program. Here, the EDDYCUFF program which has been developed by the authors is a generalized computer program to calculate transient eddy currents, resultant magnetic fields and electromagnetic forces in the conductive components. This paper describes the outline of the EDDYTRAN program system and preliminary results obtained through the application to the Tokamak reactor design which was performed for the Japan Atomic Energy Research Institute.

49020 **The impact of maximum TF magnetic field on performance and cost of an advanced physics tokamak.** Reid, R.L. (Oak Ridge National Laboratory, Oak Ridge, TN). pp 56-59 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Parametric studies were conducted using the Fusion Engineering Design Center (FEDC) Tokamak Systems Code to investigate the impact of variation in the maximum value of the field at the toroidal field (TF) coils on the performance and cost of a low q/phi/, quasi-steady-state tokamak. Marginal ignition, inductive current startup plus 100 s of inductive burn, and a constant value of epsilon (inverse aspect ratio) times beta poloidal were global conditions imposed on this study. A maximum TF field of approximately 10 T was found to be appropriate for this device.

49021 **Driven dynamo for maintenance of RFP magnetic configuration.** Miley, G.H.; Nebel, R.; Werley, K. (University of Illinois, Urbana, IL). pp 172-175 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The Reversed Field Pinch (RFP) potentially offers an attractive reactor concept. However, one crucial problem is the development of a current drive technique to lengthen the pulse time or even allow steady-state operation. The technique considered here involves creating a current via a "dynamo effect" driven by selected stable Alfven waves excited by an external antenna or waveguide. Results indicate that this may be feasible but will require multiple mode operation. An advantage, compared to some other techniques, is that use of stable waves should minimize creation of anomalous energy transport losses.

49022 **Electromagnetic analysis for fusion reactors: Status and needs.** Turner, L.R. (Argonne National Laboratory, Argonne, IL). pp 176-180 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Electromagnetic effects have far-reaching implications for the design, operation, and maintenance of future fusion reactors. Two-dimensional (2-D) eddy current computer codes are available, but are of limited value in analyzing reactors. Three-dimensional (3-D) codes are needed, but are only beginning to be developed. Both 2-D and 3-D codes need verification against experimental data, such as that provided by the upcoming FELIX experiments. Coupling between eddy currents and deflections has application in fusion reactor design and is being studied both by analysis and experiment.

49023 **A drift-pump coil design for a Tandem Mirror Reactor.** Neef, W.S.; Logan, B. (Lawrence Livermore National Laboratory, Univ. of California, Livermore, CA). pp 220-226 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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This paper describes both the theory and mechanical design behind a new concept for trapped ion removal from tandem mirror end plugs. The design has been developed for the Mirror Advanced Reactor Study (MARS). The new drift-pump coils replace charge exchange pump beams. Pump beams consume large amounts of power and seriously reduce reactor performance. Drift-pump coils consume only a few megawatts of power and introduce no added burden to the reactor vacuum pumps. In addition, they are easy to replace. The coils are similar in shape to a paper clip and are located at two positions in each end plug. The coils between the transition coil and the first anchor yinyang serve to remove ions trapped in the magnetic well just outboard of the high field choke coil. The coils located between the anchor coil set and the plug coil set remove sloshing ions and trapped cold ions from the plug region.

49024 Engineering aspects of LITE (Long pulse ignited test experiment) devices. Cohn, D.R.; Bromberg, L.; Jassby, D.L.; Williams, J.E.C. (M.I.T. Plasma Fusion Center, Cambridge, MA). pp 181-185 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The performance of copper magnet tokamaks can be substantially increased with the use of quasi-continuous plate designs. Large ignition margins and long pulse operation can be obtained in LITE-type (Long Pulse Ignited Test Experiment) devices at relatively low cost with the use of unshielded (or thinly shielded) plate magnets which are water cooled. In this paper the engineering features of LITE type machines are discussed and illustrative parameters for a range of sizes are presented. Illustrative parameters are given for a relatively small device (R = 2.44 m) for the TFCX (Toroidal Fusion Core Experiment) mission. A preliminary design for a similar size machine with a divertor is discussed.

49025 Finite difference prediction of superconductor multidimensional quench propagation and conductor pack temperature rise. O'Loughlin, J.M.; Christensen, E.H. (General Dynamics Convair Div., San Diego, CA). pp 1213-1217 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Typical superconducting magnet quench programs such as the General Dynamics SUPERQ computer code predict adiabatic conductor pack temperature rise during quench, with all the joule heat dissipated in a single conductor node and in the helium surrounding that node. If two and three-dimensional transport of energy by conduction and convection away from the node is considered, the peak temperature will be realistically reduced, and if drying is assumed, the normal zone will propagate transversely as well as longitudinally. Convair THERMAL ANALYZER (finite difference) models examine 2-D and 3-D propagation velocities of normal zones and temperature rises of the pool-boiling conductor pack during quench and different modes of current dump, in response to realistically computed joule heating, conductor pack heat transfer, helium hydrodynamics, energy transport, and storage. Temperature rise of different conductor packs with minimal boiling and no vapor flow energy transport show a general temperature rise 25K less than predicted by SUPERQ. More realistic assumptions of peripheral wetting or rewetting in better ventilated zones of the conductor pack, partial or attenuated decaying boiling in the conductor pack, and associated decaying vapor flow accompanying current dump predicts temperature rises 62% of those with SUPERQ. This model result agrees with experience obtained in the General Dynamics Large Coil Program (LCP)[2],[3] and in the Japanese Large Coil Test (LCt) magnet.

49026 Inner leg mechanics and central support concepts for large superconducting toroidal field coils. Jeske, U.; Zehlein, H. (Kernforschungszentrum Karlsruhe GmbH, Institut fur Technische Physik). pp 1218-1222 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The classic geometric ingredients for the design of large TF coils are I) a D-shaped contour usually serving as the locus of II) suitably shaped cross sections of the winding and III) a set of reinforcements required for the diffusion of external support reaction forces. The D-shape as derived by D-filament models carrying only tension hoop stresses attempts to achieve a smooth mean circumferential stress distribution. The finite extension of the cross section, however, then gives rise to considerably varying bending stresses even during normal operation. Therefore, sufficiently refined 3D finite element models are required for the stress analysis of such coils. However they are prohibitively complex for direct application to the preliminary design of Tokamak reactors. Consequently a simplified description of the coil deformation seems mandatory.

49027 MAGFOR: A magnetics code to calculate field and forces in twisted helical coils of constant cross section. Cain, W.D. (Oak Ridge National Laboratory, Oak Ridge, TN). pp 1223-1227 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The machine-independent computer program MAGFOR calculates electromagnetic fields and forces in coil systems of arbitrary geometry. The coils may be modeled by using 20-node isoparametric hexahedrons; 8-node rectangular cross-sectional straight segments; rectangular cross-sectional circular arcs; and/or filamenting circular loops. A combination of analytical and numerical integration of the Biot-Savart law for a volume distribution of current is used for calculating magnetic fields. Volumetric body forces are calculated for the 20-node isoparametric brick by numerically integrating the vector product J x B over its volume, where the magnetic field at each Gauss point is obtained by interpolating the magnetic field at the node points by using shape functions. The force is distributed to the node points of the element, again using the shape functions in a consistent manner that maintains inter-element torsion. Body forces obtained from MAGFOR are compared with body forces from the computer code EFFI for several coil configurations considered in the design of the Advanced Toroidal Facility (ATF).

49028 Magnetic design of the axisymmetric throttle-coil addition to the tandem mirror experiment-upgrade. Wong, R.L. (Lawrence Livermore Nat. Laboratory, Univ. of California, Livermore, CA). pp 1228-1232 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The TMX-U magnet set has incorporated new axisymmetric throttle coils and fan-reversing transition magnets. This new magnet geometry, which will allow for the experimental verification of new physics issues related to axicell tandem mirrors, encompasses both engineering and physics considerations. Engineering considerations include structural integrity plus neutral beam and diagnostic access. Physics issues include the stability and radial transport of the confined plasma. The authors have calculated the magnetic field using the magnetic field code, EFFI, and the plasma stability and surface curvatures using the plasma stability code, TEBASCO. The magnet design allows the axisymmetric throttle mirror to be varied from the end-cell mirror value of 2 to a peak of 6 T.

49029 Eddy current modelling and poloidal field penetration in TFTR. Brown, O.I.; Bell, M.G.; Coonrod, J. (Plasma Physics Lab., Princeton, NJ). pp 1233-1237 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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During the design and construction of TFTR, a model was developed to study the time-dependent magnetic fields generated by eddy currents induced in the machine structure. The sources of excitation of the structure were the ohmic heating (OH), equilibrium field (EF) and variable curvature (VC) windings, and the plasma current itself. In the modelling, the eddy current flow patterns were reduced to a set of defined filamentary paths for which mutual couplings and couplings to the driving circuits were calculated. The currents in the individual circuits driven by sinusoidal excitation or by arbitrary waveforms in the driving circuits were then straightforward to calculate. The influence of the structure on the poloidal field penetration was calculated from these induced currents. When the construction of the field coils and vacuum vessel of TFTR was completed, measurements were made of the field penetration when each of the poloidal field systems was excited. Comparison of the measurements with the predictions of the modelling (1) led to successive refinements of the model and the inclusion of additional structures in order to achieve satisfactory agreement. This process has illustrated a method by which penetration effects could be simulated ab initio for future devices incorporating similar windings and electrically passive systems.

49030 **Use of advanced programmable controllers in LCTF.** Thompson, D.H.; Baylor, L.R.; Fletcher, W.M.; Patek, D.R. (Oak Ridge National Laboratory, Oak Ridge, TN). pp 1999-2003 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The present generation of industrial programmable logic controllers (PLCs) offers a variety of features that are ideal for use in largescale fusion experiments. Among these features are computational capabilities, communication interfaces, ease of programming, and, most importantly, high reliability. In the Large Coil Test Facility (LCTF), three PLCs control all of the major systems, including liquid helium, liquid nitrogen, vacuum, vapor-cooled leads, coil protection, power supplies, and personnel protection. The PLC control system for LCTF is divided into three functional blocks. The first is the vacuum PLC that monitors all tank functions and has a graphic display panel on the Master Control Console (MCC). A second PLC monitors all time-critical coil protection functions and has the capability to initiate a dump of the stored energy in the coils when a setpoint is exceeded in coil or vapor-cooled lead monitoring instruments. The third PLC, which is designated the facility PLC, monitors and controls the bulk of the LCTF facility systems and serves as a redundant coil protection PLC. The facility PLC is a Modicon 584, level-IV 32K word machine with enhanced software features that include Proportional Integral Derivative (PID) control loops, block functions, and table lookups. A low-cost, color computer graphics terminal located in the MCC is attached to the Modbus link of the facility PLC and has the capability of displaying alarms and operating valves. A hard-copy terminal driven directly by the PLC logs all alarms and valve operations. Twenty-two process loops, including vapor-cooled lead flow, are controlled via the PID functions. The PLC-based control system in LCTF is the result of a philosophy that reliable control needs to be separate from data acquisition. This has resulted in a control system with maximum flexibility constructed entirely of off-the-shelf components and minimal software effort.

49031 **Manufacturing of the Swiss LCT-coil.** Horvath, Is.; Chiarolini, R.; Jakob, B.; Koch, A.; Kwasnitza, K.; Maix, R.K.; Marinucci, C.; Rauch, J.C.; Weymuth, P.; Zichy, J.A. (SIN Swiss Institute for Nuclear Research, Villigen). pp 2004-2007 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The winding of the Swiss LCT-Coil is built-up of 11 double pancakes of a cabled and soldered superconductor, with an incorporated cooling tube. The conductors and the winding are wrapped with dry glass fabric and impregnated with Epoxy-resin to form a rigid monolithic block. Impregnation took place in the reinforcing stainless steel case in which the winding is embedded. The coil is provided with a large number of probes, such as temperature sensors, helium mass flow meters, hall probes, strain gauges, heater wires, etc. Shipping of the coil to ORNL is planned for December 1983.

49032 **Performance of the magnet cryogenic power lead system for MFTF.** Van Sant, J.M. (Lawrence Livermore National Laboratory, Univ. of California, Livermore, CA). pp 2036-2039 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The cryogenic power lead system for the MFTF superconducting magnets has been acceptance tested and operated with the magnets. This system, which includes 5-m-long superconducting buses, 1.5-m-long vapor-cooled transition leads, external warm buses, and a cryostack, can conduct up to 6000 A (dc) and operate adiabatically for long periods. The authors present both design details and performance data; our MFTF version is an example of a reliable lead system for large superconducting magnets contained in a much larger vacuum vessel.

49033 **The growth of normal zones in cable-in-conduit superconductors.** Dresner, L. (Oak Ridge National Laboratory, Oak Ridge, TN). pp 2040-2043 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A picture is proposed in which the growth of normal zones in cable-in-conduit superconductors is caused by the expansion of hot helium along the length of the conductor. Quantitative results suitable for experimental testing have been obtained by dimensional and similarity arguments. The results indicate nonuniform propagation at velocities of tens of meters per second.

49034 **Pulsed field losses and intentional quenches of superconducting coils.** Kim, S.H. (Argonne National Laboratory, Argonne, IL). pp 2044 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Pulsed field losses of several 5-20 kJ coils have been measured under triangular field variations. The conductors, developed as potential subcables of 25-50 kA cables, consist of Cu wires and NbTi strands with or without CuNi barriers. Losses of soft-soldered subcables are compared with those of well-compacted cables. The coils were quenched intentionally by pulsing the coils above the critical current to observe loss variations due to possible conductor damage. The method of measurements, and effects of soldering and compactness of the conductors on the pulsed field losses will be presented.

49035 **Radiation-induced electrical breakdown of helium in fusion reactor superconducting magnet systems.** Perkins, L.J. (Lawrence Livermore National Laboratory, Livermore, CA). pp 2045-2049 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A comprehensive theoretical study has been performed on the reduction of the electrical breakdown potential of liquid and gaseous helium under neutron and gamma radiation. Extension of the conventional Townsend breakdown theory indicates that radiation fields at the superconducting magnets of a typical fusion reactor are potentially capable of significantly reducing currently established (i.e., unirradiated) helium breakdown voltages. Emphasis is given to the implications of these results including future deployment choices of magnet cryogenic methods (e.g., poolboiling versus forced-flow), the possible impact on magnet shielding requirements and the analogous situation for radiation-induced electrical breakdown in fusion RF transmission systems.

49036 **Protection of Large Superconducting Magnets: A normal-zone voltage detection method.** Ishigohka, T.; Iwasa, Y. (Francis Bitter National Magnet Laboratory & Plasma Fusion Center, Massachusetts Institute of Technology, Cambridge, MA). pp 2050-2053 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A quench-voltage detection method is described; it was developed for use with the Laboratory's 30-T hybrid magnet system. This technique can detect much smaller normal-zone voltages than those detectable with the conventional bridge-circuit technique. It is applicable to any multi-pancake-type superconducting coil, and is particularly effective in monitoring superconducting coils that are parts of multi-coil systems, including toroidal magnet systems.

49037 **Progress on AXICELL MFTF-B superconducting magnet systems.** Wang, S.T.; Hanson, C.L.; Kozman, T.A.; Shimer, D.W.; VanSant, J.H.; Zbasnik, J. (Lawrence Livermore National Laboratory, Livermore, CA). pp 1324-1328 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Since the entire Mirror Fusion Test Facility (MFTF-B) Magnet System was reconfigured from the original A-cell to an axicell design, much progress has been made on the design, fabrication, and installation planning. The axicell MFTF-B magnet array consists of a total of 26 large superconducting main coils. This paper provides an engineering overview of the progress of these coils. Recent studies on the effects of field errors on the plasma at the recircularizing region (transition coils) show that small field errors will generate large displacements of the field lines. These field errors might enhance radial electron heat transport and deteriorate the plasma confinement. Therefore, 16 superconducting trim coils have been designed to correct the coil misalignments. Progress of the trim coils are reported also.

49038 **Superconducting (radiation hardened) magnets for mirror fusion devices.** Henning, C.D.; Dalder, E.N.C.; Miller, J.R.; Perkins, L.J. (Lawrence Livermore National Laboratory, Univ. of California, Livermore, CA). pp 1329-1336 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Superconducting magnets for mirror fusion have evolved considerably since the Baseball II magnet in 1970. Recently, the Mirror Fusion Test Facility (MFTF-B) yin-yang has been tested to a full field of 7.7 T with radial dimensions representative of a full scale reactor. Now the emphasis has turned to the manufacture of very high field solenoids (choke coils) that are placed between the tandem mirror central cell and the yin-yang anchor-plug set. For MFTF-B the choke coil field reaches 12 T, while in future devices like the MFTF-Upgrade, Fusion Power Demonstration and Mirror Advanced Reactor Study (MARS) reactor the fields are doubled. Besides developing high fields, the magnets must be radiation hardened. Otherwise, thick neutron shields increase the magnet size to an unacceptable weight and cost. Neutron fluences in superconducting magnets must be increased by an order of magnitude or more. Insulators must withstand 10^{10} to 10^{11} rads, while magnet stability must be retained after the copper has been exposed to fluence above 10^{19} neutrons/cm^2. Ultimately, the neutron heating in the conductor pack and the corresponding refrigerator cost will set the neutron shielding thickness and coil size. For near-term experiments of limited duty cycle, like the Fusion Power Demonstration (FPD) or the Tokamak Fusion Core Experiment (TFCX), still larger neutron fluxes must be accomodated to reduce magnet size.

49039 **Status of the large coil test facility.** Haubenreich, P.N.; Bohanan, R.E.; May, J.R.; Miller, H.E. (Oak Ridge National Laboratory, Oak Ridge, TN). pp 1337-1341 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The Large Coil Test Facility (LCTF) is serving as the focus for international collaboration in the development of superconducting toroidal field coils. The United States is providing the test facility and three test coils. EURATOM, Japan, and Switzerland are each providing one coil, to be tested in a six-coil compact torus. Construction of the LCTF was completed in November 1983 within the $35.75 million budget established in December 1980. Concurrently with the later stages of construction, the vacuum system, the liquid nitrogen system, and the helium refrigeration system were operated in acceptance and performance tests. Two test coils with bath-cooled windings were received and installed by October 1983. Shakedown of the integrated facility systems and limited testing of the two coils are beginning in December 1983. Preparations have been made for installation of the other four test coils, which are now nearing completion in Europe and the United States.

49040 **Assembly and installation of the large coil test facility test stand.** Queen, C.C. (Union Carbide Nuclear Division, Oak Ridge, TN). pp 1342-1345 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The Large Coil Test Facility (LCTF) was built to test six tokamak-type superconducting coils, with three to be designed and built by U.S. industrial teams and three provided by Japan, Switzerland, and Euratom under an international agreement. The facility is designed to test these coils in an environment which simulates that of a tokamak. The heart of this facility is the test stand, which is made up of four major assemblies: the Gravity Base Assembly, the Bucking Post Assembly, the Torque Ring Assembly, and the Pulse Coil Assembly. This paper provides a detailed review of the assembly and installation of the test stand components and the handling and installation of the first coil into the test stand.

49041 **12 T test module coil (TMC-II) in the cluster test program.** Ando, T.; Nakajima, H.; Nishi, M.; Okuno, K.; Shimamoto, S.; Tada, E.; Takahashi, Y.; Yasukochi, K.; Yoshida, K. (Japan Atomic Energy Research Inst.). pp 1346-1349 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A 12 T-forced flow cooled test module coil (TMC-II) has been designed as the second step of the cluster test program which is demonstration program of high field toroidal coils in tokamak fusion machine. The TMC-II is a dee shaped coil with a 0.76 m x 0.92 m winding bore, and an average current density in winding is 37.5 A/mm^2 with an operating current of 11.4 kA. A cable-in-conduit type conductor, which consists of 60 strands, is selected for the TMC-II. A strand is composed of multi-filamentary (MF) Nb_3Sn superconducting material, and copper and aluminum as the stabilizer. A thermal barrier is mounted on the surface of strand to decrease thermal input due to the friction between strands. To obtain the rigidity of the winding, a stainless steel "Armor", in which is placed cable-in-conduit conductor by covered by insulator, is welded to "Armor" of the next turn. This advanced design has been performed with the strong support of the research and development.

49042 **Construction techniques for short iron-free dipole magnets.** Harvey, A.R. (Lawrence Livermore National Laboratory, Univ. of California, Livermore, CA). pp 1203-1206 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A method was developed for economically fabricating short, wire-wound, steering magnets with maximum length, cosine-distributed, axial elements. This method utilizes multifunctional tooling to precisely flat-wind two-layer dipole halves that are subsequently reformed and encapsulated into semicylindrical form with confinement of the end turns into thin, half discs normal to the magnet axis. This paper addresses the magnet fabrication in detail, highlighting the inherent quality control features of the tooling, overall construction costs, and contemplated manufacturing enhancements.

49043 **Eddy current losses in tokamak components defined by surfaces of a cylindrical coordinate system.** Kalnavarns, J. (MPB Technologies Inc., Dorval, Quebec). pp 1207 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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In tokamaks there are numerous examples of cylindrical conductors subjected to time-varying axial magnetic fields. The principal eddy current modes over a circular cross-section are usually suppressed by at most a few insulating breaks. On the other hand, a configuration exhibiting a large number of cuts is the hollow cylinder formed by the plates of the inner legs of wedged toroidal-field coils. For a scenario of closely-spaced plasma-current pulses as planned for the Varennes Tokamak, the high-order modes repetitively excited in the segmented bucking column and in the coil conductors that lie within the Ohmicheating solenoid can constitute a serious loss mechanism. To form an accurate assessment of the time-development of the dissipation and the effective flux swing, the magnetic-field diffusion problem is solved analytically for a cylinder of specified inner and outer radii subdivided into an arbitrary number of sectors. In the limit of a long geometry the sectors are uncoupled and can be treated independently. The assumed applied magnetic-field pulses are generated by superposition of ramps with offset origins.

49044 Quality assurance aspects of the major procurements for the large coil test facility. Taylor, D.J.; Halstead, E.L.; Murphy, J.L.; Queen, C.C.; Ryan, T.L.; Thompson, P.B.; Wood, R.J. (Oak Ridge National Laboratory, Oak Ridge, TN). pp 1133-1137 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The Large Coil Test Facility (LCTF) project is comprised of the test stand, supporting cyrogenic systems, instrumentation, data acquisition, and utilities necessary for testing the large superconducting coils of the Large Coil Program (LCP). A significant portion of the facility hardware has been obtained through procurement actions with industrial suppliers. This paper addresses the project's experience in formulation and execution of quality assurance (QA) actions relative to several of the major items procured. Project quality assurance planning and specific features related to procurement activities for several of the more specialized test facility components are described. These component procurements include: (1) the coil test stand's major structural item (the bucking post) purchased from foreign industry, (2) fabrication and testing of high-current power supplies, (3) industrial fabrication of specialized instrumentation (voltage-tap signal conditioning modules), and (4) fabrication, installation, and testing of the liquid helium piping system. Each of the items selected has unique characteristics requiring careful consideration to ensure visibility and control of critical quality-related aspects of each particular procurement. Quality planning; experience with each supplier; results from the fabrication, installation, and testing conducted; and recommendations related to how well the original plans matched actual events are covered. A summary with a discussion of areas that should receive different attention in future, similar procurements is also included.

49045 Calculations for the reflection magnet for the ASDEX long pulse neutral injection beamline. Schneider, P.J.; Feist, J.H.; Mckolajczak, P. (Max-Planck-Institut fur Plasmaphysik, EURATOM Association). pp 530-533 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The design of the reflection magnet for the ASDEX long pulse neutral injection system is described. Ion trajectories through the magnet were calculated with a pseudo 3-D magnetic field which was generated from the results of calculations with a 2-D magnetic field code (POISSON). The ion trajectories were followed until the ions either hit the magnet pole faces or the ion dumps. The distribution of the intersection points of the ion trajectories with the ion dumps (footprint) was the criterion for determining the specific parameters of the magnet. Once the parameters for the magnet were determined, the effects of the ASDEX stray fields were included in the trajectory calculations to determine the necessity and degree of magnetic shielding in the region of the magnet and the region between the neutralizer exit and the magnet.

49046 Safety concerns for superconducting magnets of upcoming fusion experiments. Turner, L.R. (Argonne National Laboratory, Argonne, IL). pp 516 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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-Several fusion experiments being constructed (Tore Supra) or contemplated (DCT 8, Alcator DCT) feature superconducting coils. These coils introduce the following safety concerns: 1. Internally Cooled Conductor (ICC). ICC's are found to be highly stable against short heat pulses, even when the coolant is stagnant or moving at low steady-state velocity. However, a large heat pulse is certain to quench the conductor. Thus, determining the stability limits is vital. 2. Helium II Cooling. Helium II has both unique advantages as a coolant and unique safety problems. 3. Shorted Turns. In magnets with shorts from operational accidents, the current can switch back and forth between the short and the shorted turns, as those alternatively go normal and superconducting. 4. Hybrid Superconducting-Normal Conducting Coil System. The possibility of unequal currents in the different magnets and thus of unexpected forces on the superconducting magnets is much greater than for an all-superconducting system. Analysis of these problems are presented.

49047 The engineering and final assembly of S-1 Spheromak Flux Core. Helmich, R.C.; Dahlgren, F.; Mullaney, D.; Reilly, B.; Snook, P. (Plasma Physics Lab. Princeton Univ., Princeton, NJ). pp 743-747 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The Flux Core of the S-1 Spheromak (Figure 1) is a torus with a major radius of 1m and a minor radius of 19 cm. The primary elements within it are the PF and TF (Poloidal and Toroidal) windings which are a water cooled copper cable, two turns of EF (equilibrium Field) coils, and an epoxy-glass mandrel to support them. Surrounding these are an aluminum shell, potting material, and a thin, highly resistive Inconel liner which is a vacuum boundary. After the winding of the TF cables (see previous report for 9th Symposium), a built-up layer of dry interwoven fiberglass tape was wound around the entire flux core. The fiberglass, when vacuum impregnated, provides structural support. Next, the four piece aluminum shell which also served as an enclosure for vacuum impregnation was applied. The epoxy used in this operation was cured at low temperature to insure integrity of the PF/TF polyethylene insulation. After impregnation, a wet layup of fiberglass/air cure epoxy was wound over the aluminum shell for further structural support. The Inconel liner, which had been spun, ground, and chem-milled to a 0.254 mm thickness, was welded in position about the circumference at the midplane. A midplane band of 2.286mm thickness was left for this purpose along with elements to provide for closure welding of vacuum feedthru assemblies. The annulus between the liner and fiberglass/ epoxy structural wrapping was then pressure potted with urethane. This material was chosen because it would bond to the Inconel and fiberglass yet would allow for thermal expansion. The completed flux core was then installed between the domes of the S-1 vacuum vessel. Initial testing of S-1 indicates that the fabrication techniques have proven successful. A detailed description of the fabrication, installation, and testing will follow.

49048 TFTR TF-coil lead stem assemblies-manufacture, installation and testing. Loesser, D.; Cargulia, G.; Materna, P.; Rarnes, G.; Zatz, I.J. (Princeton University, Plasma Physics Laboratory, Princeton, NJ). pp 738-742 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Manufacturing steps for the TFTR (TF) coil flexleads are described. Processes requiring development included a brazed joint of 25 thin copper sheets sandwiched between two thick bars; stud-welding to a curved surface; and electrical insulating cuffs having compound curvature. Procedures for fitup and installation and electrical testing of the leads are also described.

49049 TFTR TF-COIL lead stem assemblies-design and analysis. Zatz, I.J.; Barnes, G.; Cargulia, G.; Loesser, D.; Materna, P. (Princeton University, Plasma Physics Laboratory, Princeton, NJ). pp 733-737 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The Tokamak Fusion Test Reactor (TFTR) toroidal field (TF) coils have flexible lead stems which differ from conventional buswork configurations. Each of the twenty TF coils experiences a maximum current of 73 kiloamperes. The current path includes the TF coil lead stem which extends from the TF coil lead block/outer turn to the TF circular ring bus. Due to the current levels and spatial constraints imposed on the lead stem design, a detailed definition of the electromagnetic loads, relative motion between the lead stem and supporting structure, thermal response and overall structural behavior were required to define a configuration that fulfills the TFTR design requirement of 300,000 full power pulses. Several finite element models were generated to examine the behavior of various components of the lead stem and its supporting structure. These results are presented in detail, with particular attention given to the lead block/outer turn interface. The design methodology in going from the finite element analysis to the actual structure is presented as well.

49050 **TFTR poloidal field coil lead splice program.** Viola, M. (Princeton Plasma Physics Laboratory, Princeton, New Jersey). pp 729-732 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The TFTR Poloidal Field Coils consist of nine "upper" and "lower" stacks. These were manufactured by Brown Boveri Corporation and Princeton Plasma Physics Laboratory (PPPL). Brown Boveri manufactured stacks one through five and PPPL manufactured stacks six through nine. PPPL manufactured the stacks that were considered too large to ship safely over a long distance. The coils were manufactured with short stubs, for the lead stems, that projected perpendicularly to the plane of the coil. They were short because the impregnation process employed vacuum impregnation techniques that would have been difficult to accomplish with full-length lead stems projecting from the coil. Further, it was considered too dangerous to transport the coils with the full-length stems attached, due to their fragile nature. The attachment of the full-length lead stems was done at PPPL in their coil shop and TFTR Test Cell. Stacks eight and nine had to be done in the test cell, since they would not fit through the installation area doorway with the lead stems attached. In the interest of scheduling and time, the lead stem of the smaller coils (stacks three through five and six upper) were attached in the coil shop and the remaining in the test cell. Each coil was preimpregnated and pretested prior to the lead splice being performed. One advantage of delaying the lead splice to the coils was the ability to make last-minute decisions in the design of the termination details. The exact method for connecting the coils to the buswork and the supporting of the buswork had been left until the coils were installed. This was in order to more efficiently design around any potential interferences that became evident after installation.

49051 **TFTR poloidal field coils and umbrella structure preassembly and installation.** Moss, B.F.; Pien, C.C.; Rocco, R.E.; Ross, T.K. (Ebasco Services Incorporated, Forrestal Campus, Princeton, NJ). pp 724-728 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A modular concept was employed to assemble the major components of the Tokamak Fusion Test Reactor (TFTR). The Poloidal Field (PF) coils are sets of large water cooled loops located outside the Toroidal Field (TF) coils and parallel to the plasma. A brief description of the major PF coil components and their function, their preassembly and the placement of the lower PF coils on the machine floor is presented. The installation and assembly sequence required that the upper PF coils be preassembled with the upper support (Umbrella) Structure. In addition, in order to conserve schedule, the upper PF coils were pre-aligned relative to each other in parallel with the assembly of the umbrella segments. The procedures and tooling required to satisfy the installation criteria will be discussed. Since the Umbrella Structure was the heaviest lift (100 tons with 110 ton capacity crane) a discussion of the lift procedure and its review process will be presented. The installation of the coil bus work, and the bus work cooling and support systems will be described. The effect of using craft labor on the installation will be discussed. Finally, the actual locations of the lower and upper PF coils are tabulated.

49052 **TFTR Inner Support Structure final assembly and installation.** Rocco, R.E.; Brown, G.; Carglia, G.; Heitzenroeder, P.; Koenig, F.; Mookerjee, S.; Raugh, J. (Ebasco Services Inc., Princeton, NJ). pp 719-723 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The Inner Support Structure (ISS) of the TFTR provides a specific level of restraint to the net centering force and overturning moment produced by the Toroidal Field (TF) coils and to the vertical forces produced by the Inner Poloidal Field (PF) coils. This is accomplished consistent with the need for four radial dielectric breaks running the entire length of the ISS to prevent eddy current loops. A brief description of the major components, method of manufacture and material selection of the ISS and PF coils is presented. Particular attention is given to the integration of the PF coils and the ISS components into the total assembly and the installation of strain gauges and crack monitors on the ISS. The requirements of no gaps at the interfaces of the ISS teeth at all three horizontal planes is discussed. The problem encountered with achieving the no gap requirement and the successful resolution of this problem, including its impact on installation of the ISS, is also discussed. The installation of the ISS, including setting in position, preloading with TF coil clips, and final tensioning of the tension bars is discussed. A brief description of the lower and upper lead stem splicing operation is presented. Subsequent to the final assembly, electrical tests were performed prior to and after installation on the TFTR machine. An overview of the tests and their results is presented.

49053 **Sector module installation in the TFTR.** Ross, T.K.; Spinos, F. (Ebasco Services Incorporated, Forrestal Campus, Princeton, NJ). pp 709-713 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The Tokamak Fusion Test Reactor (TFTR) contains an interconnected array of twenty toroidal field (TF) coils, radially aligned around an Inner Support Structure (ISS) hub. The TF coil array envelopes the toroidal vacuum vessel which consists of ten segments of equal arc. Based on a modular design methodology, each vacuum vessel segment is associated with the one-tenth section of TF coil array (consisting of two TF coils and four structural panels) that surrounds it. The vacuum vessel segment/TF coil array section is known as a sector module, and weighs nearly 70 tons. It is the intent of this paper to concentrate primarily on the assembly and installation of the TF coil array components of the sector module. The TFTR installation schedule required that a sector module be installed every two weeks. This plan necessitated that sector module preassembly operations parallel the installation efforts of another sector module. A detailed description of the strategy, procedures, and tooling required to satisfy installation criteria will be given. The effect of using craft labor for installation operations will be covered. The manner in which the components were sub-assembled and fitted into place in the Tokamak are discussed along with the solutions to close tolerance alignment problems.

49054 **Pulsed, low error, high current TF and VF coils with demountable joints.** Mako, F.; Altes, R.; Golden, J.; Kupetanakos, C.A.; McDonald, K.; Pasour, J.A.; Pershing, D.E.; Smith, K. (Naval Research Lab., Washington, DC). pp 705-708 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The main magnetic field coils that produce the pulsed toroidal (TF) and vertical (VF) magnetic fields for the NRL modified betatron accelerator (MBA) have been analyzed and designed. This device is to accelerate multikiloampere electron beams to 50 MeV energy on an orbit of major radius, r /SUB o/ = 1 m. Dynamic (rise time about 3 msec) magnetic field precision is better than 1% in the spatial region of interest. At peak currents (TF:210 kA, VF:45 kA) the coils, buswork and supporting structure have been designed for stiffness so that field error producing deflections will be small. In addition, field errors associated with the coil leads are kept small by utilizing a linear to coaxial transition for the lead from each coil to the coaxial buswork. Field errors associated with eddy currents in the support structure are kept small by using plastic and stainless steel composite components that have a short magnetic diffusion time. Accelerator access is readily achieved by using demountable joints on the TF coils. High current density (2kA/ cm^2), low bolting force joints are attainable with a louvered interface material (multilam.)

49055 **Poloidal field system design for the ZT-4OU reversed field pinch experiment.** Schoenberg, K.F.; Gribble, R.F.; Linton, T.W.; Reass, W.R. (Los Alamos Nat. Lab., Los Alamos, NM). pp 699-704 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The poloidal field system in a reversed field pinch (RFP) provides two important functions. It induces the toroidal electric field that drives the plasma current over the duration of the discharge, and it provides the magnetic boundary conditions necessary for plasma equilibrium. In ZT-4OU, this functional dichotomy is achieved by using two separate systems of coils. The equilibrium winding, which provides the vertical field and field index necessary for plasma equilibrium, and the magnetizing winding, which provides the flux swing and magnetic energy necessary to set up and maintain the discharge. A cross sectional drawing and flux plot of the poloidal field system is shown.

49056 **Optimum design of polyhelix coil.** Hanai, S.; Nakasima, K.; Shibui, M.; Takano, H. (Toshiba Corp., Yokohama). pp 688 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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This paper presents a method that looks very promising for obtaining an optimum configuration of a polyhelix coil for fusion device application. It has long been known that high hoop stress limits applicability of the usual tape coil to a ohmic heating coil having high magnetic field. The polyhelix coil consisting of many thin solenoids, although no such limited applicability, has many difficulties in manufacture. From this point of view, the polyhelix coil should be made to have optimum configuration that minimizes thermal and electromagnetic loadings. Detailed stress analyses of the polyhelix coil are carried out to obtain its optimum configuration and to examine its integrity. The results show that the mechanical behavior of the coil is strongly influenced by two factors: bonding strength of turn insulations and the spiral angle of the solenoid. The stress state near winding ends is also affected by these factors. Because of the poor shearing rigidity, the polyhelix coil is not so strong against external pressure like loadings. Further, methods of manufacturing the polyhelix coil and reducing stress level near the winding ends are discussed. The solution to the optimum design of an example coil is also presented.

49057 **Nonlinear elastic-plastic analysis of Ignitor TF coils and their support structure.** Moazed, A.R.; Terry, R.A. (Stone & Webster Engineering Corporation, Boston, MA). pp 683-687 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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This paper discusses a feasibility study of the Ignitor fusion device conceptual design. Unique features of the design are 1) wedge-shaped sectors to facilitate assembly and maintenance, 2) precompression of entire device using circumferential loading rings to minimize external support, and 3) use of high confinement and elastic-plastic analysis techniques to permit use of low strength oxygen-free high-conductivity (OFHC) copper for toroidal field (TF) coils. This provides an economical and functional advantage over current high strength copper coils. The finite element code, ANSYS, was used with an axisymmetric model in the analysis. The TF coils and support structure were modeled using isoparametric elements with plasticity considered in the case of the coils. Nonlinear, friction resisting, interface elements were used to model the interaction between individual component parts. These same nonlinear spring elements were also used to produce the compressive effects of the circumferential loading rings. To ensure convergence in the plastic range, electromagnetic and thermal loads were applied at steps of varying increments. The values of stress and strain for each element and exaggerated deformation plots for the model were obtained at each load step. The results of this analysis verified the practicality of the loading ring preload concept and the acceptability of low-strength copper coils when adequately confined.

49058 **Modeling the shape of a noncircular toroidal field coil.** Shah, V.N.; Marshall, N.H. (EG & G Idaho, Inc., Idaho Falls, ID). pp 682 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Operating and transient forces acting on toroidal field coils may cause conductors and insulation to slide or break and may lead to quenching of the coil. Therefore, it is essential that each individual turn of the coil be modeled for detailed analysis of the coil structure. For this, a special purpose computer program is needed. As a first step in developing such a computer program, the authors present a finite element analysis of a turn of noncircular coil subjected to electromagnetic loading. A turn of superconducting coil is represented by a thin ring modeled by curved finite elements. Of the several curved beam elements reported in the literature, the strain element with two nodes, six degrees-of-freedom, and constant radius of curvature converges fastest for thin-deep arches whose geometrical characteristics are similar to those of a turn of toroidal field coil. They present an algorithm to model a noncircular ring using the number of strain elements satisfying the continuity of slopes at their nodes. This paper verifies the finite element model of a coil shape subjected to a toroidal magnetic field by solving three problems: circular and elliptic coils with the same inner and outer radii, a D-shaped coil, and a compound coil consisting of C- and D-shaped segments. The first problem shows that the resultant vertical force in the upper half of the coil is independent of coil shape. The remaining two problems calculate stresses that represent the constant tension in the D-shaped coil and in each segment of the compound coil. The results of the three problems compare well with the analytical results.

49059 **Magnet design approach for pulsed tokamak reactors.** Kim, S.H.; Ehst, D.A.; Evans, K. (Fusion Power Program, Argonne National Laboratory, Argonne, Illinois). pp 677-681 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A choice of various operating modes of a tokamak reactor will have considerable impact on the fatigue lives and cost of ohmic heating (OH), equilibrium field (EF), and toroidal field (TF) coils. OH and EF coil requirements and their costs, as well as the effects of the fringing fields of the EF coils on the TF coils, have been studied under cyclic operation in the range of $N = 10^2$ to 10^6 cycles, spanning the range from a noninductively driven reactor (STARFIRE) to a conventional ohmically driven reactor. For a reference design of TF coils the design of the central OH solenoid has been studied as a function of its maximum field, B /SUP OH/. Increasing requirements for structural support lead to only negligible increases in voltseconds for B /SUP OH/≧ 10.0 T. Fatigue failure of the OH coil is not a concern for $N \leqq 10^5$; for N about 10^6 fatigue limits the strain to small values, resulting in small increases in structural requirements and modest decreases in volt-seconds. Should noninductive current drive be achievable the authors note that this not only eliminates the OH coil, but it also permits EF coil placement in the inboard region, which facilitates the creation of highly shaped plasma cross sections (large triangularity, or bean-shaped equilibria). They have computed the stored energy, coil configuration and fringing fields for a number of EF coil design options. For pulsed operation these EF coil fields result in three major problems. First, the induced eddy currents introduce additional heating to the TF magnets, which increases cryogenic demands compared to steady-state operation. Second, of greater concern, these EF coils impart out-of-plane forces and turning moments to the TF coil structure. In this case fatigue failure is a severe design constraint. Finally, pulsed operation of the EF coils requires large, expensive power supplies.

49060 Fabrication of JT-60 poloidal field coil. Ohkubo, M.; Kamiya, H.; Kaneko, M.; Kohda, T.; Masuda, M.; Morita, T.; Watanabe, T. (Japan Atomic Energy Research Inst.). pp 664-667 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The poloidal field coil (PFC) of JT-60 is located inside of the toroidal field coil (TFC), and the PFC has the split section for the TFC assembling. As the result, the PFC, becomes the most complicated coil in the world. So, the authors have developed some new technical methods for the PFC, and we have done many kinds of reliability tests. This paper describes the specification of the PFC, the reliability tests for the PFC, and the procedures of the manufacture and the inspection.

49061 Design and construction of big dee poloidal coils & their support structure. Bott, R.; Jones, J.D. (GA Technologies Inc., San Diego, CA). pp 660-663 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The construction of the Big Dee tokamak requires the replacement of several Doublet III poloidal coils with a lesser number of new coils. Eight of the new coils will be enclosed in a 1.27 cm thick stainless steel box beam. The box beam will react part of the loads generated in the encapsulated copper conductor and transmit other loads around it. Coil lead supports will be attached to the box beam, transmitting their loads directly to the support structure. The new outer E-coils (ohmic heating coils) will be encased with the new field shaping coils. The water cooled copper conductor will be wound with alternating layers of fiberglass and Kapton tape and placed in the stainless steel box beam to be vacuum impregnated with epoxy resin. The support structure will consist of horizontal box beams (coil cases) and columns. The box beams will be of welded construction except for a bolted joint that allows the two halves of the assembly to be separated for the removal of the encapsulated coil. Electrically insulated breaks will be provided in the box beam and at the column/box beam interface. The support structure will locate and support the vacuum vessel by means of four trunnions located at the midplane of the vessel.

49062 Design, fabrication, and testing of the pulse coils for the large coil test facility. Chipley, K.K.; Parrelli, A.P. (Union Carbide Corporation Nuclear Division, Oak Ridge, TN). pp 656-659 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The Large Coil Test Facility (LCTF) will be able to test up to six large superconducting coils similar to those required for a tokamak reactor. In order to simulate the transient vertical field that will be part of the magnetic environment of an operating tokamak reactor, a set of pulse coils will be used in the facility. This set of two coils can be positioned in the bore of any of the test coils to provide a transient magnetic field to that particular coil. This paper describes the final design of the pulse coils and discusses the fabrication techniques used to build these coils. An extensive testing program has been carried out during fabarication to ensure that the coils will function satisfactorily.

49063 Design, manufacture and performance of the JET Toroidal field coils. Huguet, M.; Booth, J.; Pohlchen, R. (JET Joint Undertaking, Abingdon, Oxfordshire). pp 652-655 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The JET Toroidal field magnet compromises 32 D shaped coils each 5.7 m high, 3.8 wide and weighing 12 tonnes. The field produced is 3.45 Tesla at 2.9 m radius when operating at the maximum current of 66.5 kA. The coils are wound with water cooled hollow conductor and operate with an equivalent rectangular current pulse length of 20 seconds at full current. A description of the evolution of the design in relation to the constraints imposed is given first. These design constraints included the low aspect ratio of the Torus, the long pulse duration, the large mechanical forces and also the availability of suitable copper conductor sections. The stress analysis of the coil is outlined as well as the cooling requirements and some specific stresses. The construction of the D shaped coils in hard copper presents problems due to the spring back effect of the conductor. The methods adopted to solve these difficulties together with other problems related to the winding process are given. A large number of tests were carried out in order to establish the conditions necessary to obtain reliable brazed joints. During production the non destructive tests for each joint were very severe and included X-ray examination. In order to meet the JET delivery programme, a large effort has been required in terms of production tools and organization of the work at the supplier's works. This effort and the construction schedule is outlined. After assembly on the JET machine the TF coils have been tested and their initial performances in electrical, mechanical and thermal terms are compared with predicted values.

49064 Low activation coil system of R-tokamak. Hamada, Y.; Kitagawa, S.; Kizazawa, H.; Kuno, K.; Matsuoka, K.; Matsuura, K.; Metoki, N.; Ohmori, J.; Swada, Y.; Toi, K. (Institute of Plasma Physics, Nagoya University, Nagoya). pp 866-870 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Technical problems of low-activation coil system with aluminum alloy for R-tokamak are discussed. Most of the poloidal coils, coil support and shear panel can be made of low activation aluminum alloy. The authors made however the following choice of materials for TF coil; copper conductor, coil case of aluminum alloy and lead shield because large square wave time of toroidal coil current is necessary in case of the aluminum vacuum vessel for the suppression of eddy current effect. The large force due3 to the interaction of high TF coil field and eddy current in lead shield in case of disruption, will be suppressed through the use of lead shield as the composite materials; the many pieces of lead buried in fibre reinforced epoxy (FRP).

49065 INTOR magnetics and electromagnetics - phase IIA results. Knobloch, A.F. (Max-Planck-Institut fur Plasmaphysik, Munchen). pp 848-852 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The INTOR TF magnet system with a maximum field of 11 T appears to be feasible, but further R and D design-specific to INTOR parameter ranges will be required to ensure its practical feasibility. An intermediate-sized pancake test between large test coils (e.g. LCT coils) is an example of how to bridge the gap between practical experience at the LCT level and an INTOR prototype coil. PF coil distribution studies show that the overall TF coil size has a strong effect, and that a poloidal divertor involves a cost penalty compared with a pumped limiter. In the 'universal' configuration as of Phase IIA both the limiter and divertor cases can be realized over the whole B-range. PF coil designs are all based on NbTi since PF configuration studies indicate field levels of ≦ 8 T. Restriction of AC losses is a major constraint. Fault studies assuming terminal shorting show certain PF coils to be subjected to abnormal currents, thus requiring active protection. R and D on pulsed superconducting magnets is much less advanced than on TF coils.

49066 Parametric system studies of candidate TF coil system options for the Tokamak Fusion Core Experiment (TFCX). Reiersen, W.T.; Flanagan, C.A.; Miller, J.B. (Grumman Aerospace Corp., Bethpage, NY). pp 843-847 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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System studies were performed to determine the sensitivity of hybrid and superconducting toroidal field (TF) coil system options to maximum field at the TF coil and to field enhancement due to resistive insert coils. The studies were performed using Tokamak

Fusion Core Experiment (TFCX) design assumptions, guidelines, and criteria and involved iterative execution of the Fusion Engineering Design Center (FEDC) systems code, magnetohydrodynamics (MHD) equilibrium code, and EFFI (a code to evaluate magnetic field strength). The results indicate that for TFCX with no minimum wall loading specified, a design point chosen solely on the basis of cost would likely be in the low-field region of design space where the cost advantage of hybrids is least apparent. However, as the desired neutron wall loading increases, the hybrid option suggests an increasing cost advantage over the all-superconducting option; this cost advantage is countered by increased complexity in design – particularly in assembly and maintenance.

49067 An 18 T solenoid concept for MFTF-B. Schultz, J.H.; Diatchenko, N. (M.I.T. Plasma Fusion Center, Cambridge, MA). pp 827-833 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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MFTF-α + T is a next step mirror device designed to upgrade the MFTF-B tandem mirror facility to a generic nuclear testing facility for the magnetic fusion program. The solenoid magnet concepts, in particular an 18 T choke coil, reflect the dependence of the tandem mirror concept on high performance, highly irradiated solenoids. The achievement of an 18 T solenoid with a 22 cm bore is a significant accomplishment in the total absence of radiation. The achievement of a normal magnet with a fluence of 4 X 10^{12} rads of absorbed neutron and gamma radiation in its insulation is a significant achievement in the total absence of field. The achievement of a superconducting magnet with an instantaneous radiation absorption of 65 mW/cm^3 and an insulation fluence of 10^{10} rads, let alone a magnet with a peak field of nearly 16 T and a 107 cm bore, is unprecedented. The superconducting and normal coils in the 18 T magnet system are also subjected to asymmetric axial loads from external magnets, adding the requirement of being able to support normal and fault loads in either axial direction. Nevertheless, it appears that design solutions do exist.

49068 Construction of the JFT-2M TOKAMAK (4) – design and fabrication of coil system –. Kuno, K.; Nagata, D.; Narikawa, T.; Takagi, S. (Mitsubishi Electric Co., Koebe-City). pp 647-651 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The JAERI TOKAMAK-JFT-2M is a large piece of equipment that has a main structure weighing 230 tons and consists mainly of coil systems that include iron cores. The main parts of the design, developmental tests, and the fabrication of these coils are described. The experiment on JFT-2M is in two stages; the current Phase I and the upgraded Phase II, but the toroidal field (TF) coils, S1 through S3 and H coil are scheduled to be used also in Phase II. The TF coils that consists of 16 coils and weighs 56 tons are made in D-shape to conform to the cross-sectional shape of the plasma. To be able to withstand the strong electromagnetic force applied in the Phase II tests, these coils were designed as canned coils, and the conductors were designed with as large as possible cross sections to limit heating. The direct support of the inward magnetic force by the center iron core is among the unique features of the system. Among the 9 types of PF coils, the ones inside the TF coils and the ones outside have completely different design objectives. The iron core consists of 4 blocks. The circular core at the center has OH and B coils. To support the inward magnetic force of the TF coils, the center core was designed and fabricated with high rigidity despite its laminated structure.

49069 A model for stresses in circular magnets for toroidal fusion devices. Noterdaeme, J.M.; Lidsky, L.M.; Montgomery, D.B. (Plasma Fusion Center, Massachusetts Institute of Technology, Cambridge, MA). pp 642-646 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The coil is modelled as a circular beam on elastic foundation. The elastic foundation allows us to take into account the reaction provided by the wedging effect of the coils and the turn over (or intercoil) structure. From the known solutions for a single force acting on such a beam, the authors obtain the formulas for an arbitrary cos $n\theta$ variation of a distributed force. By applying Fourier expansion of the in-plane loads and external reaction forces (as provided by a central bucking cylinder), we can calculate displacements, bending moments, normal and shearing forces. Bending moments in circular coils are reduced when only a small fraction (1/5) of the net inward force is taken up by a central cylinder.

49070 Study of the RFX circuits with a 0-dimensional plasma model. Maschio, A.; Ortolani, S.; Piovan, R. (Istituto Gas Ionizzati del CNR - Associazione EURATOM-CNR - Padova). pp 633-636 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The poloidal and toroidal circuit performance of the Reversed Field Pinch experiment RFX is studied with a circuit plasma model which accounts for the coupling of the two circuits by constraining the evolution of the magnetic field distribution in the plasma. RFP configurations at 2 MA current and β /SUB uj/ =0.1 can be produced with pulse length up to 250 ms.

49071 Computer simulation of magnetic field circuits in ATF. White, J.A.; Googe, J.M.; Nickels, L.E. (Oak Ridge National Laboratory, Oak Ridge, TN). pp 624-626 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The proposed design of the Advanced Toroidal Facility (ATF) contains several closely coupled magnetic field circuits that are being modeled using the SUPER*SCEPTRE computer program in order to predict their transient behavior. The results of this transient analysis study will be used to determine component values and/or special precautions that may be required for power supply and other circuit element protection due to the mutual coupling between circuits. ATF is a continuous-coil torsatron device using resistive coils in a pulsed mode of operation in which a current fluctuation in one coil induces voltages in the other circuits that may not be desirable. The model contains the solid-state power supplies' equivalent circuits, the resistance and self-inductance of each magnetic field coil, and the mutual inductances of every coil combination. The SUPER*SCEPTRE program allows for the direct input of all electrical components as well as the mutual inductances. The power supply voltages are entered as preprogrammed wave shapes designed to achieve the desired magnetic field strengths. The outputs of this program are tables and plots of voltages and currents associated with each circuit component.

49072 Effects of aspect ratio on magnetics of tokamaks with Quasi-continuous magnets. Bobrov, E.S.; Bromberg, L. (Francis Bitter National Magnet Laboratory, Massachusetts Institute of Technology, Cambridge, MA). pp 619-623 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A scoping study is performed of LITE (Long Pulse Ignited Test Experiment) type machines that use quasicontinous toroidal field magnets. The mission for the Toroidal Fusion Core Experiment (TFCX) is the basis for the assumptions. The physics criteria for ignition and the main engineering constraints of the toroidal field magnet are held fixed. The ensuing tradeoffs are discussed. A scoping study is performed to indicate the trends as the ignition margins are varied. Furthermore, the implications of using RF current drive for start up are discussed.

49073 Magnet systems for "Bean-Shaped" tokamak. Jassby, D.L.; Bromberg, L.; Cohn, D.R.; Mendelsohn, S.; Okabayashi, M.; Raynes, D.; Stiner, D.J.; Todd, A.M.; Williams, J.E.C. (Princeton Plasma Physics Laboratory, Princeton, NJ). pp 215 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Bean-shaping of tokamak plasmas offers a method of reaching stable operation at (beta) > 10%. In order to establish the indentation of the "bean", a set of high- current "pushing coils" (> 5 MA in a reactor) must be located at the midplane as close as possible to the inboard edge of the plasma. If located in the bore of the TF coils, then maintenance of the pushing coils may be impossible, and the interlocking coils may prevent reactor modularity. If located outside, the required pushing-coil current may be unacceptably large. This dilemma is overcome with a unique TF coil design in which the inboard leg is bent outward in the form of an arc. The pushing coils are housed in the midplane indentation of this arc, just outside the TF coils but adequately close to the plasma. The arched coil transfers forces to the top and bottom legs, where it can be reacted by a clamp structure if necessary. This technique would allow demountable joints to be placed near the inoard leg (for copper TF coils). Another design approach to the pushing coils is to use liquid Li or Na as the conductor and coolant. The liquid metal "coils" can be placed immediately adjacent to the plasma, giving optimal control of the plasma shape with minimal coil current, although modularity of the reactor may have to be surrendered. Conceptual designs are presented of PF and TF coil systems for an ignition test reactor with <B> about 14% and for a full-scale demonstration reactor with <B> about 20%, both using copper TF coils.

49074 **Trim coils and magnet alignment in MFTF-B.** Yamaguchi, G.T.; Baldwin, D.E. (Lawrence Livermore Nat. Lab., Univ. of California, Livermore, CA). pp 821-825 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Performance of the MFTF-B tandem mirror reactor is critically dependent upon precise alignment of the superconducting magnets in the transition region. Given the size and nature of these magnets, mechanical alignment under operating conditions to the tolerances required is an impossible task, as placement must anticipate deflections due to vacuum conditions, cooling to cryogenic temperatures, and magnetic forces. A cost-effective solution to the alignment problem is presented here. In each transition region, a set of eight trimming magnets capable of introducing dipole- and quadrupole-field components allows field curvatures to be finely tuned to offset the effects of mechanical alignment errors. Trimming current values for correcting representative single- and multiple-coil misalignments, as well as an analytic method for determining them are given. Finally, design considerations that will minimize the need for trim coils in future tandem mirror devices are suggested.

49075 **Switching transients in a superconducting coil.** Owen, E.W.; Shimer, D.W. (Lawrence Livermore National Laboratory, Livermore, CA). pp 816-820 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A study is made of the transients caused by the fast dump of large superconducting coils. Theoretical analysis, computer simulation, and actual measurements are used. Theoretical analysis can only be applied to the simplest of models. In the computer simulations two models are used, one in which the coil is divided into ten segments and another in which a single coil is employed. The circuit breaker that interrupts the current to the power supply, causing a fast dump, is represented by a time and current dependent conductance. Actual measurements are limited to measurements made incidental to performance tests on the MFTF Yin-yang coils. It is found that the breaker opening time is the critical factor in determining the size and shape of the transient. Instantaneous opening of the breaker causes a lightly damped transient with large amplitude voltages to ground. Increasing the opening time causes the transient to become a monopulse of decreasing amplitude. The voltages at the external terminals are determined by the parameters of the external circuit. For fast opening times the frequency depends on the dump resistor inductance, the circuit capacitance, and the amplitude on the coil current. For slower openings the dump resistor inductance and the current determine the amplitude of the voltage to ground at the terminals. Voltages to ground are less in the interior of the coil, where transients related to the parameters of the coil itself are observed.

49076 **Smaller coil systems for tokamak reactors.** Bateman, G.; Fox, J.R. (School of Nuclear Engineering and Health Physics, Georgia Institute of Technology, Atlanta, Ga.). pp 812-815 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Ripple reduction by ferro-magnetic iron shielding is used to reduce the size of the toroidal field coils down to 7.8 by 10.4 m bore for a commercial tokamak reactor design with plasma parameters similar to STARFIRE. For maximum effectiveness, it is found that the blocks of ferromagnetic iron shielding should have triangular cross section and should be placed as close to the plasma as possible.

49077 **Shear stress peaks in a superconductor cable during the winding of a large toroidal field coil.** Zehlein, H. (Kernforschungszentrum Karlsruhe GmbH Institut fur Reaktorbauelemente, Arbeitsgruppe Zuverlassigkeit und Schadenskunde im Maschinenbau, Karlsruhe). pp 807-811 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The paper presents a simplified elastica conductor model (SECM) built by a finite chain of intervals with constant bending moment and curvature. The problem does not allow to linearize the curvature. A bilinear moment-curvature relationship as derived from bending experiments was used to describe the elastoplastic behaviour of the cable under different tension forces acting on the "free" end near the supply spool. Due to the geometric and material nonlinearities mentioned no direct solution is possible. The paper describes the discrete model as well as the iterative shooting method which finds the equilibrium shape of the conductor. The distributions of bending moment and shear forces on the D-shaped contour as well as along the conductor are given. They show a pronounced influence of the tension force in the relevant range of 1 to 40 kN. An inconsistency due to compromising model simplifications is shown which occurs at the contour points where the curvature radius suddenly changes. Remarks on the elastic springback of the superconductor observed there conclude the paper.

49078 **ATF superconductor and coil design characteristics.** Lue, J.W.; Brown, R.L.; Miller, J.R. (Oak Ridge National Laboratory, Oak Ridge, TN). pp 803-806 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A study was initiated to look into the possibility of building a novel superconducting Advanced Toroidal Facility (ATF) magnet system. The system would operate initially at liquid nitrogen temperature as a pulsed system. At the time of the study, a modular torsatron-type magnet system was being considered. A superconducting coil built with a copper-jacketed Internally Cooled Superconductor (ICS) can produce an ATF coil with high current densities at high fields. A geodesic method of winding is described that can make the winding of the complex-shaped coils more feasible than the older, conventional methods. With this geodesic winding, the conductor can be pulled with tension, and thus elaborate clamps are not needed to prevent sideward slipping or bunching of the conductors. The bobbin can be machined on numerically controlled machines having several axes of movement. A preliminary simulation test indicates that initial pulse operation of these coils at liquid nitrogen temperature is feasible. Pulse operation at half the superconducting design field (B /SUB M/ = 5.0 T) can be sustained for more than 4 s without excessive temperature and pressure rise.

49079 **Progress of the Argonne Pulsed Cable Test Facility.** Kim, S.H.; Knott, M.J.; Krieger, C.I.; McGhee, D.G. (Argonne National Laboratory, Argonne, IL). pp 800-802 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Initial tests of the Pulsed Cable Test Facility (PCTF) at Argonne National Laboratory (ANL) have been completed. Additional components are prepared for the tests of developmental high-current cable conductors: a minicomputer based data acquisition system, a new 5.5 MW power supply for triangular or trapezoidal pulsing modes of the PCTF coil, and a pair of 25 kA current leads for the transport current of the testing conductors.

49080 **MFTF-α+T end plug magnet design.** Srivastava, V.C.; O'Toole, J.A. (General Electric Company/Grumman Aerospace Corporation, Fusion Engineering Design Center, Oak Ridge National Laboratory, Oak Ridge, Tennessee). pp 795-799 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The conceptual design of the end-plug magnets for MFTF-α+T is described. MFTF-α+T is a near-term upgrade of MFTF-B, which features new end plugs to improve performance. The Fusion Engineering Design Center has performed the engineering design of MFTF-α+T under the overall direction of Lawrence Livermore National Laboratory. Each end plug consists of two Yin-Yang pairs, each with about 2.5:1 mirror ratio and about 5-T peak field on axis; two transition coils; and a recircularizing solenoid. This paper describes the end-plug magnet system functional requirements and presents a conceptual design that meets them. The peak field at the windings of the end-plug coils is about 6 T. These coils are designed using the NbTi MFTF-B conductor and cooled by a 4.2K liquid helium bath. All the end-plug magnets are designed to operate in the cryostable mode with adequate quench protection for safety. Shielding requirements are stated and a summary of heat loads is provided. Field and force calculations are discussed. The field on axis is shown to meet the functional requirements. Force resultants are reported in terms of winding running loads and resultant coil forces are also given. The magnet structural support is described. A trade study to determine the optimum end-cell coil internal nuclear shield thickness and the resulting coil size based on minimizing the end-cell life cycle cost is summarized.

49081 **Irradiation effects on superconducting materials of MCFR magnets.** Ma, B.M. (Department of Nuclear Engineering, Iowa State University, Ames, Iowa). pp 790-794 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The irradiation effects on the critical current, I /SUB c/ ; critical current density, J /SUB c/ ; transition or critical temperature, T /SUB c/ ; electric and residual electric resistivity, /rho/, /rho/ /SUB o/ or Δ/rho/; pinning force density or pinning force per unit volume, F /SUB p/ ; and specific pinning force or pinning force per crystal lattice defect, Q; and the mechanical properties of superconductors such as Nb_3Sn, Nb_3Ge, and NbTi for magnetic confinement fusion reactor (MCFR) magnets are analyzed based on experimental results. Results show changes in the irradiated superconductors can greatly influence the design, construction, operation, and performance of the MCFR magnets.

49082 **Hybrid choke coils of 17.5 T for TASKA-M.** Arendt, F.; Maurer, W. (Kernforschungszentrum Karlsruhe GmbH, Institut fur Technische Physik). pp 784-789 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The design of a 17.5 T choke coil is described. The coil is provided as a hybrid with a normal-conducting inner part and a superconducting outer part. Design constraints and routines are described in view of the following aspects: layout of the normal-conducting insert for minimum power consumption, composition of the superconductor composite with respect to critical data, electrical stabilization, and mechanical reinforcement, radial position due to neutron shielding requirements and lifetime of the coil.

49083 **Helium leak testing the Westinghouse LCP coil.** Merritt, P.A.; Attaar, M.H.; Hordubay, T.D. (Westinghouse Electric Co., East Pittsburgh, PA). pp 783 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The tests, equipment, and techniques used to check the Westinghouse LCP coil for coolant flow path integrity and helium leakage are unique in terms of test sensitivity and application. This paper will discuss the various types of helium leak testing done on the LCP coil as it enters different stages of manufacture. The emphasis will be on the degree of test sensitivity achieved under shop conditions, and what equipment, techniques and tooling are required to achieve this sensitivity (5.9 x 10^{-8} scc/sec). Other topics that will be discussed are helium flow and pressure drop testing which is used to detect any restrictions in the flow paths, and the LCP final acceptance test which is the final leak test performed on the coil prior to its being sent for testing. The overall allowable leak rate for this coil is 5 x 10^{-6} scc/sec. A general evaluation of helium leak testing experience are included.

49084 **Design, testing and fabrication of the header region joints in the Westinghouse LCP coil.** Jarbak, A.J.; Fetzko, R.D.; Hordubay, T.D.; Tobias, J.B. (Westinghouse Electric Corporation, East Pittsburgh, PA). pp 778-782 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The Westinghouse LCP coil is manufactured by winding a Nb_3Sn conductor, encased in a stainless steel sheath, into grooves, which are machined in aluminum structural plates. The coil winding is a double pancake design with each set of windings being joined in the header region at the top of the coil. This coil configuration provided some challenging design, manufacturing and quality assurance problems in the joints of the header region. In addition, processes had to be developed which insured that these joints could be made consistently and meet all requirements. The winding pancakes in the coil were designed electrically in series; therefore, a joint was developed that could both carry the electrical current and mechanical load. These conductor joints are butt joints, and made by a resistance welding procedure. The electrical resistance of these joints was tested to be 10^{-9} to 10^{-10} ohms, and 4K Lhe mechanical tests showed adequate strength with at least a safety factor of 3.

49085 **Design of the coolant system for the large coil test facility pulse coils.** Bridgman, C.; Ryan, T.L. (Grumman Aerospace Co., Bethpage, NY). pp 774-777 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The pulse coils will be a part of the Large Coil Test Facility in Oak Ridge, Tennessee, which is designed to test six large tokamak-type superconducting coils. The pulse coil set consists of two resistive coaxial solenoid coils, mounted so that their magnetic axis is perpendicular to the toroidal field lines of the test coil. The pulse coils provide transient vertical fields at test coil locations to simulate the pulsed vertical fields present in tokamak devices. The pulse coils are designed to be pulsed for 30 s every 150 s, which results in a Joule heating of 116 kW per coil. In order to provide this capability, the pulse coil coolant system is required to deliver 6.3 L/s (100 gpm) of subcooled liquid nitrogen at 10-atm absolute pressure. The coolant system can also cool down each pulse coil from room temperature to liquid nitrogen temperature. This paper provides details of the pumping and heat exchange equipment designed for the coolant system and of the associated instrumentation and controls.

49086 **Normal zone detectors for a large number of inductively coupled coils.** Owen, E.W.; Shimer, D.W. (Lawrence Livermore National Laboratory, Livermore, CA). pp 769-773 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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In order to protect a set of inductively coupled superconducting magnets, it is necessary to locate and measure normal zone voltages that are small compared with the mutual and self-induced voltages. The method described in this paper uses two sets of voltage measurements to locate and measure one or more normal zones in any number of coupled coils. One set of voltages is the outputs of bridges that balance out the self-induced voltages. The other set of voltages can be the voltages across the coils, although alternatives are possible. The two sets of equations form a single combined set of equations. Each normal zone location or combination of normal zones has a set of these combined equations associated with it. It is demonstrated that the normal zone can be located and the correct set chosen, allowing determination of the size of the normal zone. Only a few operations take place in a working detector: multiplication of a constant, addition, and simple decision-making. In many cases the detector for each coil, although weakly linked to the other detectors, can be considered to be independent.

49087 **D-T axicell magnet system for MFTF-α+T.** Srivastava, V.C. (Fusion Engineering Design Center/General Electric Company, Oak Ridge National Laboratory, Oak Ridge, Tennessee). pp 764-768 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The configuration and design of the deuterium-tritium (D-T) axicell superconducting magnets for the Mirror Fusion Test Facility (MFTF-α+T) are described. The MFTF-α+T is an upgrade of the MFTF-B, with new end-plug magnets and a neutron-producing central D-T axicell section. The 4-m-long axicellits length defined by the 12-T peaks in the mirror field -- is beam fueled and heated by two beam lines, each with four neutral beam injection ports. Two large superconducting coils (mean diameter about 3.8 m) located at $Z = +$ or - 2.40 m, in conjunction with a small copper coil located outside the test volume region, produce the 4.5-T mirror midplane field. This background field is augmented by two copper coils to create the 12-T peak mirror fields at $Z = +$ or - 2 m. The central region of the axicell accommodates a 1-m-long, replaceable blanket test module. The length (4 m) of the axicell was chosen to provide relatively uniform neutron wall loading over the test module. In many respects, this axicell is less than full scale, but it could be viewed as a short section of a reactor, complete with the support systems and technologies associated with a mirror reactor. The peak field at the superconducting coils is 10.8 T. The coils employ hybrid superconducting winding -- Nb$_3$Sn conductor in the 8- to 12-T region and NbTi in the 0- to 8-T region. The winding is cryostable and is cooled by a 4.2 K liquid helium bath. The conductor design, the winding design, and the performance analyses for these superconducting coils are described.

49088 **Coil system design of medium sized superconducting tokamaks.** Shimamoto, S.; Ando, T.; Hiyama, T.; Kato, T.; Koizumi, K.; Nishi, M.; Okuno, K.; Oshikiri, M.; Takahashi, R.; Takahashi, Y. (Fusion Research Center, Japan Atomic Energy Research Institute). pp 760-763 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Current status of the design of medium-sized superconducting tokamak machines, using LCT-like coils, is described. As the first step, a 8-T tokamak was considered and basic analysis was made from the view point of the structural design, examining the criteria and process required for the design of structural system. As the second step, a 12-T upgraded system is being considered and tentative parameters of the conductor and the winding is described.

49089 **Assembly and installation of a pair of superconducting buses for the large coil test facility.** Moore, J.W. (Union Carbide Corporation-Nuclear Division, Oak Ridge, TN). pp 757-759 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The Large Coil Test Facility in Oak Ridge, Tennessee was built to test six large tokamaktype superconducting coils. The test facility is designed to test these coils in an environment which simulates that of a tokamak. Current is supplied to the coil through the high current leads in the Superconducting Bus Assembly. Two of these assemblies interface with each test coil inside the test facility vacuum vessel and with the vapor-cooled lead assemblies outside the vacuum vessel. Since the high current leads are required to be superconducting, the Bus Assembly is designed to be filled with liquid helium for cooling. Under some test conditions, there is relative motion between the coil interface and the vacuum vessel interface. The Bus Assemblies are designed to accommodate this motion plus thermal conditions. This paper provides a detailed review of the design, fabrication, assembly, and installation of a typical bus pair.

49090 **Acoustic Emission Monitoring of LCP superconducting magnets.** Jacob, K.; Iwasa, Y.; Lue, J.W.; Miller, J.R. (Francis Bitter National Magnet Laboratory & Plasma Fusion Center, Massachusetts Institute of Technology, Cambridge, MA). pp 754-756 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Acoustic Emission (AE) techniques will be used to monitor the superconducting magnets of the Large Coil Program (LCP). A progress report of the design, installation and calibration of the AE instrumentation system for the General Dynamics (GD) LCP magnet is presented.

49091 **Toroidal magnetic field system for a 2-MA reversed-field pinch experiment.** Linton, T.W.; Melton, J.G. (Los Alamos National Laboratory, Los Alamos, NM). pp 748-753 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The engineering design of the toroidal magnetic field (TF) system for a 2-MA Reversed-Field Pinch experiment (ZT-H) is described. ZT-H is designed with major radius 2.15 meters, minor radius 0.40 meters, and a peak toroidal magnetic field of 0.85 Tesla. The requirement for highly uniform fields, with spatial ripple $\geqq$0.2% leads to a design with 72 equally spaced circular TF coils, located at minor radius 0.6 meters, carrying a maximum current of 9.0 MA. The coils are driven by a 12-MJ capacitor bank which is allowed to ring in order to aid the reversal of magnetic field. The mechanical design emphasizes easy access to the liner and avoids the interlocking of TF and PF coil structures, thus allowing easy removal of the coil assemblies. Two alternative design concepts are considered for the TF coils. The first concept utilizes a 1-inch square prefabricated cable wound onto a rotating spool which is structurally supported by wedges and bolts fastened to the machine frame. The other concept utilizes more conventional preformed 180° segments of 2-inch conductor connected through bolted current joints. A stress analysis is presented, based upon calculated hoop tension, centering force, and overturning moment, treating these as a combination of static loads and considering that the periodic nature of the loading causes little amplification. The load transfer of forces and moments is considered as a stress distribution resisted by the coils, support structures, wedges, and the structural shell.

49092 **TFTR grounding scheme and ground-monitor system.** Viola, M. (Plasma Physics Lab., Princeton, NJ). pp 1974-1976 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The Tokamak Fusion Test Reactor (TFTR) grounding system utilizes a single-point ground. It is located directly under the machine, at the basement floor level, and is tied to the building perimeter ground. Wired to this single-point ground, via individual 500 MCM insulated cables, are: the vacuum vessel; four toroidal field coil cases/inner support structure quadrants; umbrella structure halves; the substructure ring girder; radial beams and columns; and the diagnostic systems. Prior to the first machine operation, a ground-loop removal program was initiated. It required insulation of all hangers and supports (within a 35-foot radius of the center of the machine) of the various piping, conduits, cable trays, and ventilation systems. A special ground-monitor system was designed and installed. It actively monitors each of the individual machine grounds to insure that there are no inadvertent ground loops within the machine structure or its ground and that the machine grounds are intact prior to each pulse. The TFTR grounding system has proven to be a very manageable system and one that is easy to maintain.

49093 Tokamak reactor startup power. Weldon, D.M.; Murray, J.G. (Los Alamos National Laboratory, Los Alamos, NM). pp 1906-1910 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Tokamak startup with ohmic heating (OH)-induced voltages requires rather large voltages and power supplies. On present machines, with no radiofrequency (RF)-assist provisions, hundreds of volts have been specified for their designs. With the addition of electron cyclotron resonant heating (ECRH) assist, the design requirements have been lowered. To obtain information on the cost and complexity associated with this ECRH-assisted, OH-pulsed startup voltage for ignition-type machines, a trade-off study was completed. The Fusion Engineering Device (FED) configuration was selected as a model because information was available on the structure. The data obtained are applicable to all tokamaks of this general size and complexity, such as the Engineering Test Reactor (ETR). There are conflicting requirements on the torus resistance and time constant. For disruption protection, it should have a conductance higher than the plasma, after the plasma has had a major thermal disruption. Having low-resistance toroidal conductors near the plasma also reduces the active position, feedback control power requirements. The startup losses, power supplies, and coil sizes increase as the external structure, toroidal time constant increases. The ideal solution would be to provide rf current drive to initiate the plasma as well as to ramp it up to its rated value. This would allow designs to be greatly simplified. Most of the electrical resistance breaks in the piping, torus structures, and appendages to the torus could be eliminated. The savings in design and construction would be many millions of dollars. To quantify the size of the poloidal field (PF) coils and the power supplies for startup, the values were calculated for various resistances of the torus. This data will be useful in the preliminary designs for ignited tokamaks and will help quantify the advantages of development of systems to provide startup with a loop voltage of less than 1 V.

49094 More on the development of AC-MHD synchronous salient pole generator coupled to the Tokamak fusion reactor. Denno, K. (New Jersey Institute of Technology, Newark, New Jersey). pp 1820-1823 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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This paper carried out further analytical research unfolding conceptual design constraints for the MHD synchronous salient-pole generator coupled to the exhaust chamber of the Tokamak fusion reactor. Results obtained in this work identified limitation on the max. strength of magnetic excitation as well as separation among a set of line conductors for the external exciting magnetic field. Also system representation for magnetic flux linkage elements in the principle coordinate axes as well as in the symmetrical coordinate α, β, γ system as new form of mathematical modeling have been established.

49095 TFTR AC Power System. O'Neill, D.J.; Farley, R.D.; Ilic, A.V.; Stevens, A.W. (Princeton Univ. Plasma, Physics Lab., Princeton, NJ). pp 1780-1784 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A great deal has already been written about the TFTR AC Power System; however, most of this information is spread over more than a half dozen papers from prior symposia under various titles. This paper presents topics on the TFTR AC Power System which have not been addressed in previous papers. Three topics are covered, the first covers the steps taken at PPPL to increase the reliability of an existing 138 kV supply to the Laboratory. The power system into the Plasma Physics Laboratory had several vulnerable areas: the failure of certain equipment in this supply path could result in a lengthy shutdown. By adding a second 138 kV circuit breaker and careful reconfiguration of the switchyard, an alternate supply path was provided which bypassed the vulnerable areas. With this new arrangement, a major equipment failure would result in a shutdown of only a few hours. The second topic covers the emergency power system for TFTR. Included in the discussion is a description of the system, its capabilities during several modes of operation, and the addition of synchronization and parallel generation capability to the TFTR diesel generator for improved reliability. The last topic is a discussion of the protective relay coordination from the MG sets to the tokamak field coils. It is interesting to note how much protection is provided for the tokamak coils, in addition to the normal coil protection, from the Energy Conversion System power supply fault detector and the AC power system relaying.

49096 The Doublet III A.C. Power Systems. Varga, H.; Cowles, G.; Overett, T.; Ummack, F. (GA Technologies Inc., San Diego, CA). pp 1775-1789 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Doublet III is a magnetic confinement fusion experiment using the Tokamak plasma confinement configuration. Plasma experiments started early in 1978. In the succeeding five years, the demand for additional electrical power has increased as various elements have been added to the original Doublet III device, including neutral beam heating and additional plasma control power supplies. Doublet III is a pulsed device, with a repetition rate of one pulse per five minutes. The A.C. power is provided by a combination of utility supply systems and from Doublet III energy storage generators. The system incorporates special features to provide a high degree of flexibility and redundancy.

49097 Proposed inverter to link generators at PPPL. Lawn, F.; Huttar, D.E. (Princeton Univ., Plasma Physics Laboratory, Princeton, NJ). pp 1771-1774 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Large magnetic confinement experiments and the associated energy conversion systems which power the coils of such machines are a challenge to the energy supply engineer. Characteristically, the energy required per pulse is measured in gigajoules, the peak power level is hundreds of megawatts and the power supplies present a power factor of 0.6 or less to the AC supply system during the actual experiment. Direct coil supply systems such as homopolar generators and commutated DC generators are used in some cases but are not as flexible as AC power distribution systems feeding solid state rectifiers. When PPPL required high pulsed energy for the PLT and PDX machines, stored energy was obtained from existing MG sets at C-Site. These consist of three shafts each driven by a 7,000 horsepower AC motor, each shaft drives four DC generators and a flywheel. These generators combined with utility fed, static power supplies provided the energy for these machines.

49098 Design, erection and commissioning of JET flywheel-generator-convertor systems. Huart, M. (JET Joint Undertaking, Abingdon). pp 1770 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The power supply for the Poloidal and Toroidal Field Coils of the JET Tokamak relies on two dedicated flywheel-generator-convertor units to provide the necessary high voltage required during the current rise and an effective current control for current values up to 80 kA DC required during the flat top. The generator are derived from the vertical shaft hydrogenerators, in which the rotor acts as an integrated flywheel capable of storing 3.5 GJ at full speed. The particular mode of operation of the generators, characterised by 100,000 speed cycles (225-112 r.p.m.) and power derivatives of several hundreds of megawatt per second, called for careful investigation and development tests during the design phase. The erection and commissioning of the two generators was completed earlier this year. This paper describes the main characteristics of the mechanical and electrical design and sequence of erection of the generators and reviews the main aspects of the commissioning phase.

49099 **Basic design concept, installation, commissioning and operation of the JET Integrated Power Supply System.** Bertolini, E. (JET Joint Undertaking, Abingdon, Oxfordshire). pp 1756-1763 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A brief account of the main characteristics and performance of the JET Power Supply Subsystems is given in the paper. There are two Substations, the 132 kV/11 kV, 20 MVA one provides for the "continuous" AC loads, the other 400 kV/33 kV, 600 MVA supplies the pulsed loads, through the Controlled Rectifier Units for the JET Toroidal Coils, the Plasma Positioning Coils, the Neutral Injectors and the Radio Frequency Generators. The same Substation provides also power to the two Flywheel Motor Generator Sets, which complement the pulse power taken directly from the Grid, and supply the Toroidal Coils and the Ohmic Heating Coils. The concluding remarks deal with a brief technical and economic comparison between energy pulses taken from the Flywheel Generators and pulses taken directly from the High Voltage Grid.

49100 **Development of high power RF and switching tubes.** Yingst, T.; Shrader, M. (Varian Associates Inc., San Carlos, CA). pp 1692-1700 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A new generation of application data has been collected which shows that a short, large-diameter structure is the desired configuration for a power grid tube to deliver multi-megawatts of radio frequency power up to several hundred megacycles in a stable manner. Methods to evaluate the radio frequency contribution to screen grid dissipation and methods to evaluate and suppress the normal circular field resonances (TE_{11}) in a high-performance tetrode circuit have been developed. New materials are being applied to existing tetrode configurations to further improve the power output capability towards 6000 kW for another generation of multi-megawatt stable tetrodes. Finally, these configurations with slight modifications are very stable high-voltage switch tubes.

49101 **25 kilojoule energy storage capacitor, a new level of technology.** Haskell, D.K.; Bailey, W.; Cooper, R.A.; Sevingy, J.A. (Maxwell Laboratories Balboa Ave., San Diego, CA). pp 2077 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A line of high energy density capacitors, storing 25 kilojoules or more with densities exceeding 100 joules/lb., has been developed for compact energy storage banks. The development was the result of a contract funded by the Defense Nuclear Agency to design and produce a transportable multi-megajoule energy storage bank. This new level of technology builds upon performance data and experience gained from the development of high energy capacitors for LLNL's NOVA fusion program and AFWL's SHIVA program, where the principal thrust was significant reductions in volume and cost/joule. Reliability is still a requisite but shorter life spans are acceptable. This paper outlines the capacitor's characteristics, performance aspects, and discusses the various trade-offs, and rationale behind this changing technology. A brief overview of the next level of technology will be presented.

49102 **Active cooling system for the LLNL mirror fusion source test facility.** McFarlin, D.J.; Betz, A.E.; Goldner, A.; Thompson, C.C. (United Technologies Research Center, East Hartford, Connecticut). pp 526-529 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The neutral energy flux inertial heat sink in the LLNL Mirror Fusion Source Test Facility (MFSTF) has been replaced by an Active Cooling System (ACS) which is designed to be consistent with the operating characteristics of the MFSTF neutral beam system upgrade. The ACS is designed to be used in conjunction with two neutral beam sources: a 5.4 MW/0.5 second source and a 3.6 MW/30 s source. Energy is dissipated via an eleven tier array of Heat Absorption Panels (HAP). The HAP design is based on a swirl-augmented, water cooled "V" shaped heat exchanger that employs an overlapping array of small diameter molybdenum tubes. The HAPs are designed to accommodate incident beam intensities of up to 8 kW/cm^2 cw with a structural safety factor of 1.38; the calculated design cycle life is 300,000 cycles. The design allows for HAP interchangeability to accommodate material erosion due to sputtering. Cooling water is supplied by a pump-driven closedloop circulation system that is operated by a standalone control monitor unit. At design point operation the system flowrate is 45 1/s (720 GPM) at 5.31 MPa (770 psig). The initial beam on target tests of the ACS have been accomplished utilizing the 80 KeV, 5.4 MW/0.5 s source. Shots of 1/2 s length are, in effect, steady state pulses due to the short thermal time constant of the molybdenum tubes. To date, a total of 2658 shots at various power levels have been made and no degradation of beam dump performance has been observed. The test shot sequence has varied from 100 ms at 35 KeV to 400 ms at 65 KeV. Tests of 30 s duration and 80 KeV will begin in the spring of 1984 when a production long-pulse source becomes available.

49103 **Programmable controller--a versatile tool for neutral beam control.** Campbell, G.L.; Haskovec, J.S.; Moore, C.D. (GA Technologies, San Diego, CA). pp 1970-1973 of Fusion engineering. Vol. 2. New York, NY, USA; IEEE (1983). (CONF-831203—).

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In neutral beam systems (NB) for the Doublet III fusion experiment at GA Technologies Inc., programmable controllers (PC) are successfully used both on the local and the central levels of control. The local level of control is concentrated in the control instrumentation station (CI), located near the neutral beam tank and its instrumentation. The CI station contains one PC which performs control functions for vacuum, hydrogen, cooling water, automatic cryopanel defrost and recovery from power failure. The CI PC provides interface functions to other local control devices as well as to the NB control computer and central level of control. On the central level the PC creates the main part of a mode control system (MC). It supports mode control panels which serve as global control interface to NB operator, coordinates the operation of NB power supplies, central timing system, neutral beam and tokamak control computers. After a brief exposition of typical functions the implication of requirements such as expandability, reliability and versatility on hardware configuration and program structure will be explained. Results of analysis and tests of time-critical functions will be presented. Finally some aspects of interfaces to different instruments and devices will be described.

49104 **The design, fabrication and operation of the mechanical systems for the Neutral Beam Engineering Test Facility.** Patterson, J.A.; Fong, M.; Koehler, G.W.; Low, W.; Purgalis, P.; Wells, R.P. (Lawrence Berkeley Laboratory, Univ. of California, Berkeley, CA). pp 1526-1535 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The Neutral Beam Engineering Test Facility (NBETF) at the Lawrence Berkeley Laboratory (LBL) is a National Test Facility used to develop long pulse Neutral Beam Sources. The Facility will test sources up to 120 keV, 50 A, with 30 s beam-on times with a 10% duty factor. For this application, an actively cooled beam dump is required and one has been constructed capable of dissipating a wide range of power density profiles. The flexibility of the design is achieved by utilizing a standard modular panel design which is incorporated into a moveable support structure comprised of eight separately controllable manipulator assemblies. The thermal hydraulic design of the panels permits the dissipation of 2 kW/cm^2 anywhere on the panel surface. The cooling water requirements of the actively cooled dump system are provided by the closed loop Primary High Pressure Cooling Water System. To minimize the operating costs of continuously running this high power system, a variable speed hydraulic drive is used for the main pump. During beam pulses, the pump rotates at high speed, then cycles to low speed upon completion of the beam shot. A unique neutralizer design has been installed into the NBETF beamline. This is a gun-drilled moveable brazed assembly which provides continuous armoring of the beamline near the source. The unit penetrates the source mounting valve during operation and retracts to permit the valve to close as needed. The beamline also has an inertially cooled duct calorimeter assembly. This assembly is a moveable hinged matrix of copper plates that can be used as a beam stop up to pulse lengths of 50 ms. The beamline is also equipped with many beam scraper plates of differing detail design and dissipation capabilities.

49105 **MFTF-B ECRH system construction progress and preliminary test results.** Krause, K.H. (Lawrence Livermore National Laboratory, Univ. of California, Livermore, CA). pp 1426-1429 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Highly efficient Electron Cyclotron Resonance Heating (ECRH) within the thermal barrier and potential maximum regions of the Mirror Fusion Test Facility (MFTF-B) is critical to the successful operation of Lawrence Livermore National Laboratory's (LLNL) large tandem mirror experiment. In recent months, substantial progress has been made toward the commissioning of the fully integrated MFTF-B ECRH Prototype Gyrotron Socket (PGS). This facility serves as the design confirmation test bed for prototypical and first-unit ECRH components and subsystems. Acquisition of all major hardware recently culminated with the delivery and installation of the first successfully tested ECRH Power Supply System channel manufactured by Universal Voltronics Corp. (UVC) and with the receipt of the first 28 GHz CW/long-pulse gyrotron manufactured by Varian Associates. The UVC and Varian equipment has been interfaced to previously tested subsystems necessary to support PGS operations. Functional hardware now in place includes a 90 kV/90 A dc power supply, gyrotron tank, high purity water cooling skid, gyrotron magnets and power supplies, overmoded waveguide components, miscellaneous fluid support subsystems, computerized controls and monitors, and a sophisticated low power rf test facility for evaluation of quasi-optical ECRH launching system components.

49106 **Microwave measurement test results of circular waveguide components for electron cyclotron resonant heating (ECRH) of the Tandem Mirror Experiment-Upgrade (TMX-U).** Rubert, R.R.; Coffield, F.E.; Felker, B.; Stallard, B.W.; Taska, J.; Williams, C.W. (Lawrence Livermore Nat. Laboratory, Livermore, CA). pp 1430-1435 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Development of high-power components for electron cyclotron resonant heating (ECRH) applications requires extensive testing. In this paper the authors describe the high-power testing of various circular waveguide components designed for application on the Tandem Mirror Experiment-Upgrade (TMX-U). These include a 2.5-in. vacuum valve, polarizing reflectors, directional couplers, mode converters, and flexible waveguides. All of these components were tested to 200 kW power level with 40-ms pulses. Cold tests were used to determine field distribution. The techniques used in these tests are illustrated. The new high-power test facility at Lawrence Livermore National Laboratory (LLNL) is described and test procedures are discussed. The following test results are discussed: Efficiency at high power of mode converters, comparison of high power vs low power for waveguide components, and full power tests of the waveguide system. The reasons behind selection of these systems for use on TMX-U are also explained.

49107 **Neutral beam composition and purification.** Tsai, C.C. (Oak Ridge National Laboratory, Oak Ridge, TN). pp 1440-1445 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The injection of energetic neutral beams of hydrogen or deuterium is an effective plasma heating technique. To enhance the effectiveness of neutral beam applications, injectors should be developed to produce beams with a high fraction (>90%) of fullenergy atomic neutrals. Currently, positive ion sources are being used in multimegawatt neutral beam injectors. These ion sources produce not only atomic and molecular ions in their plasma generators but also partial-energy ions and neutrals in their ion accelerators. Obviously, a beam purifier must be developed to produce the high-quality beams just mentioned. In this paper, the beam composition, including associated physical processes, is elaborated. Ways to produce neutral beams with a full-energy atomic neutral fraction approaching 100% are proposed and discussed.

49108 **Operating experience with 80-keV/80-A ion sources in use for Doublet III NBI experiments.** Kim, J.; Colleraine, A.P.; Fasolo, J.A.; Hong, R.; Kamperschroeder, J.H.; McColl, D.B.; Palmer, H.L.; Silayi, R.L.; Tooker, J.F. (GA Technologies, San Diego, CA). pp 1446-1450 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The present phase of the Doublet III neutral beam injection experimental program uses three beamlines, each beamline employing twin 80 kV/80 A, 10 cm x 40 cm, LBL-type, hydrogen ion sources. This is the first neutral beam heating experiment to use industrially fabricated sources with a two-stage accelerator system and to operate at such high energy per nucleon. In this paper, the authors present actual online performance of these ion sources, compare the performance data with the design values, and discuss hardware aspects of ion source fabrication and maintenance.

49109 **Optimized baffle and aperture placement in neutral beamlines.** Stone, R.R.; Duffy, T. (Lawrence Livermore National Laboratory, Livermore, CA). pp 1451-1454 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Most neutral beamlines contain an iron-core ionbending magnet that requires shielding between the end of the neutralizer and this magnet. This shielding allows the gas pressure to drop prior to the beam entering the magnet and therefore reduces beam losses in this drift region. The authors have found that the beam losses can be reduced even further by eliminating the iron-core magnet and the magnetic shielding altogether. The required bending field can be supplied by current coils without the iron poles. In addition, placement of the baffles and apertures can affect the cold gas entering the plasma region and the losses in the neutral beam due to re-ionization. Here, they varied the placement of the baffles, which determine the amount of pumping in each chamber, and the apertures, which determine the beam loss. Results indicate that a baffle/aperture configuration can be set for either minimum cold gas into the plasma region or minimum beam losses, but not both.

49110 **Organization and performance of the neutral beam system for the Tandem Mirror Experiment-Upgrade (TMX-U).** Kane, R.J.; Hibbs, S.M.; Kerr, R.G.; Poulsen, P. (Lawrence Livermore National Laboratory, Univ. of California, Livermore, CA). pp 1455-1458 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The Tandem Mirror Experiment-Upgrade (TMX-U) at Lawrence Livermore National Laboratory (LLNL) uses 24 neutral-beam injectors to heat and fuel the experimental plasmas. This system is unique because TMX-U operates four times more injectors than any other fusion experiment. These injectors deliver an average of 50 A (accel) at 17 keV for 75 ms. Source conditioning time has been reduced to approximately four days for the entire system after extended machine air cycles. TMX-U is also unique because it has 35 usable injector assemblies for the 24 power systems. This quantity of injectors makes possible the development of new hardware and injector modifications, and the reconditioning of damaged sources without affecting machine operation. Efficient operation of a system of this size requires coordinated interaction between the injector service groups and the physics organization. The authors describe the current state of TMX-U performance and the aspects of group interaction essential to a project of this size.

49111 **Overmoded waveguide components for the ECH system on PDX.** Doane, J.L. (Princeton Univ. Plasma Physics Laboratory, Princeton, NJ). pp 1459-1464 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Waveguide components designed specifically for transmitting power into PDX for electron cyclotron heating (ECH) at 60 GHz are described. These include mode converters from the circular electric TE01 mode to the polarized HE11 mode, compact corrugated waveguide bends with a hyperbolic secant curvature variation, compact corrugated waveguide diameter tapers with a parabolic profile, and a high voltage DC break incorporating a section of dielectric waveguide, all designed for low-loss HE11 propagation. Optimization of the corrugation depth and curvature for bends propagating TE01 is also discussed.

49112 **Polarizing holographic reflector for electron cyclotron resonant heating (ECRH) on the Tandem Mirror Experiment Upgrade (TMX-U).** Coffield, F.E.; Christensen, T.E.; Felkner, B.; Gallagher, N.C.; Pedrotti, L.R.; Stallard, B.W.; Sweeney, D.W.; Wyman, E.W. (Lawrence Livermore National Laboratory, Univ. of California, Livermore, CA). pp 1469-1472 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A reflector for electron cyclotron resonant heating on the Tandem Mirror Experiment Upgrade has been designed to convert the high-power TE_{01} output of the circular waveguide system into a linearly polarized gaussian intensity pattern in the plasma. The reflector is a computer-generated holographic optical element with a twist polarizer. Its design, fabrication, and performance are discussed. Results of the low- and high-power tests are presented. Low-power tests were used to determine the beam pattern and the degree of cross-polarization. High-power tests verified that arcing across the grooves of the twist polarizer does not occur.

49113 **Preliminary design of a 20 MW ICRF power system for doublet III-D.** Remsen, D.D.B. (GA Technologies Inc., San Diego, CA). pp 1473-1475 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The heating of plasmas by waves in the ion cyclotron frequency regime is now the preferred approach for driving tokamak reactors to ignition conditions. Among the notable advantages of this approach are ready penetration into a thermonuclear plasma and an established technology for power generation. An ICRF power system for DIII-D (Doublet III reconfigured with a large dee-shaped vacuum vessel) has been designed to test the feasibility of employing such heating in a reactor. The system proposed is a narrow band RF generator operating at 55 and 40 MHz constructed in modules capable of delivering 1.25 MW each. A 20 MW, 10 s system is planned for the program envisioned. A system description is presented inclusive of RF excitation through final power amplifiers. The system layout of equipment within the D-III facility is also described. The modular nature of the total system facilitates meaningful testing at intermediate power levels, future system enlargement, and even reuse of the hardware on other facilities.

49114 **R & D works of waveguide launchers for JT-60 RF heating system.** Fujii, T.; Hara, M.; Honda, M.; Ikeda, Y.; Imui, T.; Nagashima, T.; Saigusa, M.; Sakamoto, K.; Uehara, K.; Yokokura, K. (Japan Atomic Energy Research Inst.). pp 1476-1479 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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In JT-60, lower hybrid range of frequencies (LHRF) heating at the output level of 24 MW near 2 GHz and ion cyclotron range of frequencies (ICRF) heating of 6 MW near 120 MHz are planned. An LHRF heating system has a launcher of a 32 waveguide array, 4 rows x 8 columns. Power density of 4.5 kW/cm^2 for 10 sec is required to inject the full RF power. To confirm that requirement, a launcher test stand and a test launcher of four waveguide array were constructed. The launcher test stand consists of an 1 MW class klystron, high power RF components, air flow baking system (bakable up to 500°C), vacuum pumping and so on. Waveguides of the test launcher are made of stainless steel coated with copper. Inner cross section of each waveguide is 115 mm x 35 mm which is almost the same as that of JT-60 launcher. After baking the launcher at 400°C for 72 hours, the base pressure inside the launcher reached to 2 x 10^{-8} Torr. RF power transmission of the launcher was tested with dummy load termination. Transmission power density of 5 kW/cm^2, which corresponds to 200 kW per waveguide, for 1 sec at 2 GHz was achieved after a half day s RF conditioning. During RF pulse of 160 kW, 1 sec, the base pressure increased from 4 x 10^{-8} to 10^{-7} Torr. It is found that this increment of pressure is almost that of hydrogen. For an ICRF launcher, we plan to use an array of two double T-shaped ridged waveguides as well as loop antennas. RF characteristics of the ridged waveguide are investigated from numerical calculation.

49115 **Steady-state beam dump for TFTR.** Dahlgren, F. (Princeton Univ., Plasma Physics Laboratory, Princeton, NJ). pp 1480-1483 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Future plans call for operating TFTR neutral beams for several seconds. Since the current inertial type ion beam dumps can only survive 1.0 sec-1.5 sec pulse lengths for a limited number of cycles, it will probably be necessary to replace the current ion dumps for multi-second pulsed operations. Several energy absorbing schemes have been proposed to run steady state in the 1 to 4 kw/cm^2 flux range. Rotating targets can distribute the flux load over a larger area and, depending on the velocity and total surface area of the target, reduce the power loading by as much as an order of magnitude. This solution, though quite effective suffers from some significant difficulties. Primarily the need to introduce the cooling fluid through rotating seals requires very careful design and testing, a significant level of maintenance, and has a lower level of reliability than other energy absorbing schemes. Haange has reported on the use of a hypervapotron energy absorbtion scheme for use on JET neutral beam which appears quite promising at least to flux densities of 1.0 kw/cm^2. This paper reports on the primary analysis and design results from work currently under way at PPPL to develop steady state energy absorbers in the 1 to 2 kw/cm^2 range.

49116 **Tandem Mirror Experiment-Upgrade neutral beam test stand: A powerful tool for development and quality assurance.** Hibbs, S.M.; Kane, R.J.; Kerr, R.G.; Poulsen, P. (Lawrence Livermore National Laboratory, Livermore, CA). pp 1484-1488 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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During construction of the Tandem Mirror Experiment-Upgrade (TMX-U), a test stand was assembled to develop electronics for the neutral beam system. In the first six months of test stand use the authors operated a few neutral beam injector modules and directed considerable effort toward improving the electronic system.

As system development progressed, the focus turned toward improving the injector modules themselves. The test stand has proved to be the largest single contributor to the successful operation of neutral beams on TMX-U, primarily because it provides quality assurance and development capability in conjunction with the scheduled activities of the main experiment. This support falls into five major categories: (1) electronics development, (2) operator training, (3) injector module testing and characterization, (4) injector module improvements, and (5) physics improvements (through areas affected by injector operation). Normal day-to-day operation of the test stand comes under the third category, testing and characterization, and comprises the final quality assurance activity for newly assembled or repaired modules before they are installed on TMX-U. They have also used the test stand to perform a series of physics experiments, including: reducing gas flow through valve and arc chamber characterization, reducing impurities by titanium gettering, and reducing streaming gas using apertures and collisional gas dynamics.

49117 The National RF Test Facility as a multipurpose development tool. McManamy, T.J.; Becraft, W.R.; Berry, L.A.; Blue, C.W.; Gardner, W.L.; Haselton, H.H.; Hoffman, D.J.; Loring, C.M.; Ponte, N.S.; Wright, L. (Oak Ridge National Laboratory, Oak Ridge, TN). pp 1489-1493 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Additions and modifications to the National RF Test Facility design have been made that (1) focus its use for technology development for future large systems in the ion cyclotron range of frequencies (ICRF), (2) expand its applicability to technology development in the electron cyclotron range of frequencies (ECRF) at 60 GHz, (3) provide a facility for ELMO Bumpy Torus (EBT) 60-GHz ring physics studies, and (4) permit engineering studies of steady-state plasma systems, including superconducting magnet performance, vacuum vessel heat flux removal, and microwave protection. The facility will continue to function as a test bed for generic technology developments for ICRF and the lower hybrid range of frequencies (LHRF). The upgraded facility is also suitable for mirror halo physics experiments. The base facility is a simple mirror comprising two EBT Proof-of-Principle (EBT-P) developmental superconducting magnet coils. A coil-to-coil spacing of 85 cm yields a mirror ratio of 2.7:1, so magnetic field strength ranges from 1.3 to 3.4 T. The vacuum vessel is a large, stainless steel cavity. Internal cooling panels will be added when high-power radiofrequency (rf) sources are available. Multiple ports, including one 47 cm by 162 cm, provide good access for diagnostics and testing. The expected background plasma characteristics, with 60-GHz generation, are n about 0.4-2 x 10^{13} cm^{-3} and T about 5-10 eV. Although the plasma can be ring stabilized, end losses yield an energy loss time of 2-8 μs. Elements of the upgraded facility are (1) a closed-cycle liquid helium refrigerator system, (2) an x-ray-shielded enclosure for ring physics, and (3) a 60-GHz source and test fixture. These changes, mandated by one or more of the subprograms, will dramatically increase the capabilities of the facility.

49118 The performance of watercooled grids for ASDEX long pulse neutral injection. Feist, J.H.; Kolos, J.; Mikolajezak, P.; Schneider, P.J.; Speth, E.; Wulff, G. (Max-Planck-Institut fur Plasmaphysik, EURATOM Association, D-8046 Garching). pp 1494-1497 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The present ASDEX neutral injection system will be upgraded from short pulses (0.2-0.5 sec) to long pulses (up to 10 sec). To handle the heat flux due to beam losses in the extraction system, watercooled grids have been designed, which fit onto the existing ion source and insulator. To find the most effective fabrication method, four plasma grids (equal in shape, but different in the way of manufacture) have been tested in combination with inertially cooled decel and earth grids. No significant differences could be seen between the grids made of different types of copper. However, if compared to the Molybdenum grids used before, the conditioning must be made carefully, in order to avoid damages of the surface caused by breakdowns. From 2500 to 3000 source and beam pulses were needed to bring the system up to the full performance of 55 kV and appr. 22 A. Around 70% of this power can be found on a calorimeter with nearly the same acceptance as ASDEX.

49119 The 1.5 MW ICRF heating generators for ASDEX and W VII. Schminke, W.; Hofmeister, F.; Wesner, F. pp 1498-1501 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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For the ASDEX tokamak and the WENDELSTEIN VII stellarator two 1.5 MW generators for ICRF have been built. These meet the different requirements of both experiments mainly by means of a large frequency range between 30 and 115 MHz and fast automatic switching over from one operating frequency to the other. The different requirements and the design of the generators are described.

49120 5 MW neutral beam test stand in IPP-Nagoya. Kaneko, O.; Kuroda, T.; Oka, Y.; Sakurai, K. (Inst. of Plasma Physics, Nayoya Univ.). pp 1502-1506 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A 120 keV neutral beam test stand is briefly described, which is provided for the testing and development of neutral beam injector that will be needed for Reacting Plasma Project (R-project) proposed by Institute of Plasma Physics of Nagoya University. Major components design of the test stand is based on the requirement of a prototype injector on R-project, 120 keV, 8 MW, 1 sec. Each of them is arranged to simulate the beam line injection system and the test stand can provide a wide range of experimental operating condition. The capability of each component and the performance characteristics of 1/4 scale module of the prototype ion source are outlined. A new interrupter using GTO is developed for the acceleration power supply.

49121 Review of the Tandem Mirror Experiment-Upgrade (TMX-U) machine-parameter-instrumentation system. Kane, R.J.; Coffield, F.E.; Coutts, G.W.; Hornady, R.S. (Lawrence Livermore National Laboratory, Livermore, CA). pp 1942-1945 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Abstract The Tandem Mirror Experiment-Upgrade (TMX-U) machine consists of seven major machine subsystems: magnet system, neutral beam system, microwave heating (ECRH), ion heating (ICRH), gas fueling, stream guns, and vacuum system. Satisfactory performance of these subsystems is necessary to achieve the experimental objectives planned for TMX-U operations. Since the performance quality of the subsystems is important and can greatly affect plasma parameters, a 233-channel instrumentation system has been installed. Data from the instrumentation system are acquired and stored with the plasma diagnostic information. Thus, the details of the machine performance are available during post-shot analysis. This paper describes all the machine-parameter-instrumentation hardware, presents some typical data, and outlines how the data are used.

49122 Fault detection and protection system for neutral beam generators on the Neutral Beam Engineering Test Facility (NBETF). de Vries, G.J.; Chesley, K.L.; Owren, H.M. (Lawrence Berkeley Laboratory, Univ. of California, Berkeley, CA). pp 1924-1927 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Summary neutral beam sources, their power supplies and instrumentation can be damaged from high voltage sparkdown or from overheating due to excessive currents. The Neutral Beam Engineering Test Facility (nBETF) in Berkeley has protective electronic hardware that senses a condition outside a safe operating range and generates a response to terminate such a fault condition. A description of this system is presented in this paper.

49123 **Stress analysis of neutral beam pivot point bellows for tokamak fusion test reactor.** Johnson, J.J.; Benda, B.J.; Tiong, L.W. (Structural Mechanics Associates, San Ramon, CA). pp 1844-1848 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The neutral beam pivot point bellows serves as an airtight flexible linkage between the torus duct and the neutral beam transition duct in Princeton University's Tokamak Fusion Test Reactor. The bellows considered here is basically rectangular in cross section with rounded corners; a unique shape. Its overall external dimensions are about 28 in. (about 711 mm) X about 35 in. (about 889 mm). The bellows is formed from 18 convolutions and is of the nested ripple type. It is about 11 in. (about 43.3 mm) in length, composed of Inconel 718, and each leaf has a thickness of 0.034 in. (.86 mm). The bellows is subjected to a series of design loading conditions – vacuum, vacuum + 2 psi (.12 MPa), vacuum + stroke (10,000 cycles), vacuum + temperature increase + extension, extension to a stress of 120 ksi (838 MPa), and a series of rotational loading conditions induced in the bellows by alignment of the neutral beam injector. A stress analysis of the bellows was performed by the finite element method – locations and magnitude of maximum stresses were calculated for all of the design loading conditions to check with allowable values and help guide placement of strain gauges during proof testing. A typical center convolution and end convolution were analyzed. Loading conditions were separated into symmetric and antisymmetric cases about the planes of symmetry of the cross-section. Iterative linear analyses were performed, i.e. compressive loading conditions led to predicted overlap of the leaves from linear analysis and restraints were added to prevent such overlap. This effect was found to be substantial in stress predicition and necessary to be taken into account. A total of eleven loading conditions and seven models were analyzed. The results showed peak stresses to be within allowable limits and the number of allowable cycles to be greater than the design condition.

49124 **2.45 GHz system for lower hybrid current drive on the Princeton Large Torus.** Bowen, O.N.; Bohr, A.; Lawson, J.Q.; Newman, W.; Schnabl, F. (Princeton Univ., Plasma Physics Laboratory, Princeton, NJ). pp 1722-1726 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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This paper describes a 1.5 megawatt, 2.45 GHz current drive system which is being built for use on the Princeton Large Torus (PLT) at PPL. The system is capable of pulses up to ten seconds in duration. The overall system is described, including controls, cooling, power supplies, driver stages, output klystron stages, and RF transmission system.

49125 **Circular waveguide systems for electron cyclotron resonant heating of the Tandem Mirror Experiment-Upgrade.** Felker, B.; Calderon, M.O.; Chargin, K.; Christensen, T.E.; Coffield, F.E.; Gallagher, N.C.; Lang, D.D.; Pedrotti, L.R.; Stallard, B.W.; Sweeney, D.W. (Lawrence Livermore National Laboratory, Univ. of California, Livermore, CA). pp 1718-1721 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Extensive use of electron cyclotron resonant heating (ECRH) in the Tandem Mirror Experiment-Upgrade (TMX-U) requires continuous development of components to improve efficiency, increase reliability, and deliver power to new locations with respect to the plasma. The authors have used rectangular waveguide components on the experiment and have developed, tested, and inon the experiment and have developed, tested, and installed circular waveguide components. They replaced the rectangular with the circular components because of the greater transmission efficiency and power-handling capability of the circular ones. Design, fabrication, and testing of all components are complete for all systems. In this paper they describe the design criteria for the system.

49126 **Fundamental mode rectangular waveguide system for electron cyclotron resonant heating (ECRH) for Tandem Mirror Experiment-Upgrade (TMX-U).** Rubert, R.R.; Felker, B.; Stallard, B.W.; Williams, C.W. (Lawrence Livermore National Laboratory, Livermore, CA). pp 1714-1717 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The authors present a brief history of TMX-U's electron cyclotron resonant heating (ECRH) progress. They emphasize the 2-year performance of the system, which is composed of four 200-kW pulsed gyrotrons operated at 28 GHz. This system uses WR42 waveguide inside the vacuum vessel, and includes barrier windows, twists, elbows, and antennas, as well as custom-formed waveguides. Outside the TMX-U vessel are directional couplers, detectors, elbows, and waveguide bends in WR42 rectangular waveguide. An arc detector, mode filter, eight-arm mode converter, and water load in the 2.5-in. circular waveguide are attached directly to the gyrotron. Other specific areas discussed include the operational performance of the TMX-U pulsed gyrotrons, windows and component arcing, alignment, mode generation, and extreme temperature variations. Solutions for a number of these problems are described. This system was chosen because, at the time, it required fewer inventions and utilized standard technology as much as possible. They realized at the outset that we would be giving up power in transmission efficiency. However, it was felt that reliability of the system and the ability to put power in a given polarization and a specific area would be greatly enhanced. The two-year performance indicated that although they used standard technology, they used it at a higher frequency and higher power level than had been routinely done. They discovered a number of problems which limited performance.

49127 **Review of negative ion source technology.** Leung, K.N. (Lawrence Berkeley Laboratory, Univ. of California, Berkeley, CA). pp 1709-1713 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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H^- or D^- ions are required for generating high energy neutral beams in heating fusion plasmas. Two distinct types of H^- ion sources can be identified: (1) surface sources - in which the H^- ions are generated by particle collisions with low work function metal surfaces, and (2) volume sources - in which the H^- ions are produced by electronmolecules and electron-ion collision processes in the volume of a hydrogen discharge. Recent experiments demonstrate that reasonable H^- ion current density can be obtained from both types of sources. However, further technology must be developed on the control of cesium and the reduction of electron drain before these sources become practical units of a multiampere neutral beam injection system.

49128 **Engineering of a compact D-T burning experiment.** Airoldi, A.; Bonizzoni, G.; Cenacchi, G.; Coppi, B.; DeLuca, R.; Lanzavecchia, L.; Rubinacci, G.; Scovenna, D.; Taroni, A.; Titus, P. (C.N.R.-Euratom Association, Milan). pp 2114-2118 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The main design characteristics of a compact experiment whose purpose is to attain the conditions under which the plasma heating due to the fusion reaction products is substantial, are presented. The relevant magnet systems have been optimized in order to produce a plasma column that can be adiabatically compressed from 109 cm to 74 cm. In the compressed stage plasma currents up to 4.5 MA can be induced in a plasma cross-section of 25 X 33 cm^2. Therefore, the air-core transformer and equilibrium field systems are designed to supply up to 11 volt-sec for each discharge and the toroidal magnet can produce fields in the range 12 to 15T on the magnetic axis, while the average current density in the relevant copper turns is in the range 12 to 15 kA/cm^2 that is below the values reached in the Alcator C device of MIT. The results of a complete structural analysis that evaluates the stress distribution (including that of thermal origin) during a typical plasma discharge are reported.

49129 **Design of the high final stage amplifier of the Heliotron-E for ICRH at Kyoto University.** Kalfon, C.; Asai, K.; Gerlach, P.; Iiyoshi, A.; Mutoh, T.; Onodera, T.; Sire, G.; Veda, K.; Vo, K. (Thomson-CSF, Gennevilliers). pp 1701-1704 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A first phase of an ICRH experiment on the Heliotron-E equipment at a power level of 1.5 MW with a pulsewidth of up to 200 milliseconds and capable of operating at the discrete frequencies of 17.8 MHz and 26.7 MHz has been decided at Kyoto University. Practical implementation of the corresponding final amplifier stage, using a single tube output stage is described in this paper along with the test procedures, performance figures and output tube protection.

49130 **JT-60 radio frequency heating system and testing of 1 MW-10 sec klystron.** Nayashima, T.; Fujii, T.; Hara, M.; Honda, M.; Iida, K.; Ikeda, Y.; Imai, T.; Kimura, H.; Nakamura, T.; Saigusa, M. . (Japan Atomic Energy Research Inst.). pp 1705-1708 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A system feature is presented of a 30 MW, 10 sec Radio frequency (RF) heating system for JT-60. Two kinds of RF heating methods are to be employed on JT-60, namely Lower Hybrid Range of Frequencies (LHRF) heating and Ion Cyclotron Range of Frequencies (ICRF) heating. The JT-60 LHRF heating system has three units of eight RF generators to produce 24 MW of power at 2 GHz, and the JT-60 ICRF heating system one unit of eight generators of 6 MW at 120 MHz. Development of a high power klystron for the LHRF heating system was started in the end of 1980 and completed in August 1983. The final tube under development had successfully delivered a power of 1 MW for 10 sec at the frequency of 2 GHz. JAERI is now starting the construction of the RF heating system for JT-60.

49131 **Fabrication, installation and testing of the JET ohmic heating circuit.** Ericksson, T.; Mondino, P.L.; Raymond, C.; Stella, A. (JET Joint Undertaking, Abingdon, Oxfordshire). pp 2070-2076 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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After a review of the JET Ohmic Heating (OH) Circuit, its modes of operation are discussed and the individual components are described, through design, fabrication and testing. The integrated tests are presented with Dummy Load and with the JET Poloidal Field (PF) Coils. The experience gained on the OH Circuit with the early operation of JET is reported.

49132 **Concepts for spheromak plasma heating for reactor operation.** Miley, G.H.; Olson, R. (Fusion Studies Laboratory, University of Illinois, Urbana, Illinois). pp 261-263 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Potentially large magnetic energy and fusion power densities are two of the most attractive features of the spheromak reactor concept. Its high magnetic energy density allows for the possible ohmic ignition of an MHD stable plasma. Also a large fusion power density results in a compact nuclear island. Here the authors examine some techniques for blending these attractive characteristics into an ohmically ignited, high-power density reactor.

49133 **Material failures observed in the Doublet III neutral beamlines.** Bailey, E.W.; Colleraine, A.; Doll, D.; Grunloh, H.; Kim, J.; Langhorn, A.; Thurgood, B. (GA Technologies Inc., San Diego, CA). pp 2015-2018 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The Doublet III neutral beam injectors consist of three separable spools two meters in diameter by four meters long overall when assembled. Contained within these spools are the neutralizers, ion dumps, deflecting magnet, calorimeter dumps, cryogenic panels and beam scraping collimators. To date three beamlines are in operation on Doublet III, and the beams have accumulated operating time of approximately 32 months, with the oldest having been in operation for 18 months. During this time operation of DIII with the neutral beam sources has demonstrated the following: 7.8 MW injected neutrals from three beamlines (6 sources), high β (4.5%), and non-circular plasma shape. The sources have also exibited a very reliable injected shot history. Material failures encountered during the operation of DIII N.B. injectors and the solutions to these failures are described. Failures include cracking of the neutralizer exit collimator due to heating cycles, failure of cyropanel support rods due to cooling cycles, failure of the sliding drive of the moveable calorimeter due to friction.

49134 **Beam extraction at the Prototype Injector Unit for JT-60.** Akiba, M.; Araki, M.; Dairaku, M.; Horiike, H.; Kawai, M.; Komata, M.; Matsuda, S.; Mizuhashi, K.; Okumura, Y.; Shirakata, H. (Japan Atomic Energy Research Inst.). pp 2021-2025 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The Prototype Injector Unit has been constructed to test and demonstrate single beam line performances prior to fabrication of the 14 injector units for JT-60. Operation of the system was started in December 1981, and ion beams of 75 keV, 70 A, which is the standard design conditions for JT-60, were extracted for 10 sec in February, 1982. This beam produced a total neutral beam power of 1.43 MW with a proton ratio of 80%. Reionization loss was 5% of the total neutral beam power and the blocking effect of the drift tube was not observed. An attempt to increase beam energy up to 100 keV, resulted in successful operation at 100 keV, 70 A, 10 sec in March 1983. Through these tests, design performance of the ion sources, beam line components, and cryopumping system was confirmed. In parallel with these tests, a new advanced source plasma generator was developed to provide a higher proton ratio. Performance tests on this new source were initiated at the prototype injector unit in August 1983. Ion beams of 90 keV, 30 A, 10 sec and 100 keV, 39 A, 6.8 sec were extracted so far using one advanced source. The neutral beam power of 0.73 MW, which corresponds to 20 MW neutral beam injection, was produced with a beam energy of 75-90 keV and a reionization loss of 4-5%. The advanced source has been adopted as the production ion source for the JT-60 Neutral Beam Injection system.

49135 **Neutral beam injectors for the Big Dee vessel.** Doll, D.W.; Bailey, E.; Colleraine, T.; Fasolo, J.; Hayer, R.; Peron, A.; Rawls, J.; Sanchez, H. (GA Technologies Inc., San Diego, CA). pp 2026-2030 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The four neutral beam injectors built for Doublet III will be modified to reoptimize beam transmission into the Big Dee vessel. All beamline components will be remounted 90° to their original position in the cylindrical vacuum vessel. This will permit optimum alignment with the available port opening. While these modifications are being incorporated into the disassembled injectors, it is planned that improvements and upgrading features will be added at the least possible cost. The calorimeter will be replaced by two independently driven calorimeters, thus decoupling the operation of the two ion sources. The beam path is being opened up to accommodate a long pulse (cw) source and all beam absorbing surfaces are being increased in size to withstand up to 5 s of operation with heat fluxes up to 700 W/cm^2. By opening up the apertures along the beam trajectory, an increase in power transmission into the plasma of 33% is realized compared with the present Doublet III performance. In addition to improving the performance of the present system, this modification allows for the simple replacement of the present field free sources with larger cw sources to be developed and available at a later date. Ultimately, the four injectors will be capable of delivering up to 16 MW of heating into the Big Dee for up to 5-second pulses.

49136 **Calculation of neutron fluxes, activities and gamma Dose-Rates in the deuterium operated Frascati Tokamak Upgrade machine.** Pedretti, E.; Nicola, C.Di. (E.N.E.A., Roma). pp 1244-1254 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Frascati Tokamak Upgrade will be a deuterium operated machine in which a high neutron yield is expected when using full power RF heating. Safety problems related to neutron activation have been assessed through evaluation of neutron fluxes by the ANISN code in various directions with a plasma neutron source radially peaked on axis and energetically peaked at 2.45 (95%) and 14 (5%) MeV; calculation of specific activities of radiosotopes generated by 3024 not-uniformly distributed shots and determination of gamma dose-rates at various locations by the three-dimensional Monte Carlo code Mercure-4. Dose-rates vs. cooling time for one year after the last shot are reported. The results show that, although not prohibitively high, the activation of a high neutron yield deuterium operated machine can not be neglected.

49137 **Monte Carlo simulation of an MCF fuel system.** Zuckerman, D.S.; Wagner, L.M. (McDonnell Douglas Astronautics Co., St. Louis, MO). pp 1166-1170 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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This paper describes a computerized technical performance simulation of an MCF D-T fuel system. The code is designed to examine the relative technical merits and development risks of various options for five major fuel subsystems: Plasma Chamber Evacuation, Blanket Tritium Recovery, Impurity Removal, Low-Level Tritiated Water Processing and Isotopic Separation. Two or three different options were examined for each subsystem. For the overall fuel system, three major technical performance parameters were defined by which to evaluate the different combinations of subsystem options: net tritium loss to the environment, sum of subsystem tritium inventories and purity of fuel being returned to the reactor. The past, present and expected future performance of each of the subsystem options with respect to these parameters were obtained from various experts. Since most of these options do not currently exist commercially, probability distributions for each parameter were constructed using the experts' opinions. Using these data as input, the computer simulation uses a Monte Carlo sampling technique to calculate the overall performance parameters and the general constituent flows throughout the fuel system. Results indicate that existing options for the five subsystems studied can be expected to achieve the required levels of performance for commercial MCF operation and that tritium inventories and losses as well as fuel purities are quite reasonable.

49138 **Methodology for technical risk assessment.** Waganer, L.M.; Zuckerman, D.S. (McDonnell Douglas Astronautics Company, St. Louis, MO). pp 1128-1132 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A methodology has been developed for and applied to the assessment of the technical risks associated with an evolving technology. This methodology, originally developed for fusion by K. W. Billman and F. R. Scott at EPRI, has been applied to assess the technical risk of a fuel system for a fusion reactor. Technical risk is defined as the risk that a particular technology or component which is currently under development will not achieve a set of required technical specifications (i.e. probability of failure). The individual steps in the technical risk assessment are summarized. The first step in this methodology is to clearly and completely quantify the technical requirements for the particular system being examined. The next step is to identify and define subsystems and various options which appear capable of achieving the required technical performance. The subsystem options are then characterized regarding subsystem functions, interface requirements with the subsystems and systems, important components, developmental obstacles and technical limitations. Key technical subsystem performance parameters are identified which directly or indirectly relate to the system technical specifications. Past, existing and future technical performance data from subsystem experts are obtained by using a Bayesian Interrogation technique. The input data is solicited in the form of probability functions. Thus the output performance of the system is expressed as probability functions.

49139 **Neutral beam power supply timing interlocks.** Kohli, J.C.; Campbell, G.L.; Haskovec, J.S.; Kamperschroer, J.; Lee, G.; Lee, S.T.; Moore, C.D.; Nerem, A.; Tooker, J.F.; Treglio, J.R. (GA Technologies Inc., San Diego, CA). pp 492-495 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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This paper describes interlocks and timing for GA Technologies Neutral Beam Power Systems (NBPS). Each NBPS requires timing signals which fire the Filament, Arc, Suppressor, Gas and Modulator/Regulator (M/R). The M/R output accelerates the primary hydrogen beam. Each of these timing signals is interlocked in a similar manner. This paper concentrates on the interlocking of the M/R as a representative example. A figure shows how the M/R timing channel is derived and conditioned by an enable and various interlocks to yield a signal which gates on the M/R.

49140 **Fusion Power Demonstration - A baseline for the mirror engineering test reactor.** Henning, C.D.; Campbell, R.B.; Clarkson, I.R.; Gordon, J.D.; Logan, B.G.; Neef, W.S.; Nelson, D. (Lawrence Livermor National Laboratory, Univ. of California, Livermore, CA). pp 420-425 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Developing a definition of an engineering test reactor (ETR) is a current goal of the Office of Fusion Energy (OFE). As a baseline for the mirror ETR, the Fusion Power Demonstration (FPD) concept has been pursued at Lawrence Livermore National Laboratory (LLNL) in cooperation with Grumman Aerospace, TRW, and the Idaho National Engineering Laboratory. Envisioned as an intermediate step to fusion power applications, the FPD would achieve DT ignition in the central cell, after which blankets and power conversion would be added to produce net power. To achieve ignition, a minimum central cell length of 67.5 m is needed to supply the ion and alpha particles radial drift pumping losses in the transition region. The resulting fusion power is 360 MW. Low electron-cyclotron heating power of 12 MW, ion-cyclotron heating of 2.5 MW, and a sloshing ion beam power of 1.0 MW result in a net plasma Q of 22. A primary technological challenge is the 24-T, 45-cm bore choke coil, comprising a copper hybrid insert within a 15-18 T superconducting coil.

49141 **An advanced performance Fusion Engineering Device based on low safety factor and current drive (FED-A).** Peng, Y.K.M.; Rutherford, P.H. (Oak Ridge National Laboratory, Oak Ridge, TN). pp 415-419 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The FED-A study aims to quantify the potential improvement in cost-effectiveness of the Fusion Engineering Device (FED) by assuming low safety factor q at the plasma edge and noninductive current drive. The FED-A performance objectives (ignition, neutron wall load, and power-reactor-like operation) are set to be equal to or better than those of the FED Baseline. The results show that assuming magnetohydrodynamic (MHD) q/PSI/ (edge) to be 1.8 permits reduction in device size and plasma current and leads to a 30% reduction in direct cost. A closely fitted, 1.5-cm-thick, continuous water-cooled shell made of the copper alloy AMAX-MZC (0.6 Cr, 0.1 Zr, 0.03 Mg) is proposed to provide a 0.5-s time constant, to help avoid disruption when q/PSI/ passes near 2, and to mitigate disruption impact. The lower hybrid wave current drive in a cyclic density operation is proposed to achieve a quasi-steady-state operation permitting a design with low toroidal loop voltage and a 1000-s burn time.

49142 **Initial start-up of a Tandem Mirror Reactor.** Firestone, M.A.; Conn, R.W.; Mau, T.K. (University of California, Los Angeles, CA). pp 206-210 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The physics constraints imposed by particle and power balance and RF heating in the center and end cells of a tandem mirror reactor (TMR) have been analyzed for the initial start-up period (prior to the establishment of electrostatic plugging). The resulting equations yield guidelines for achieving desired operating parameters. Additionally, a specific start-up scenario is presented with numerical estimates based upon MARS parameters.

49143 **Design of a separator/neutralizer to limit impurities and non-primary species in the Mirror Fusion Test Facility.** Goldner, A.I. (Lawrence Livermore Nat. Lab., Univ. of California, Livermore, CA). pp 572-578 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The optimum plasma for the tandem Mirror Fusion Test Facility (MFTF-B) at Lawrence Livermore National Laboratory (LLNL) is very sensitive to heavy contaminates, such as oxygen and metals. Unfortunately the current neutral beam sources generate not only high energy deuterium particles but also high energy oxygen particles. A new MFTF-B separator/neutralizer has been designed to filter out the unwanted oxygen and allow only primary species neutrals to reach the plasma.

49144 **Design of a high power ICRF transmission system for D-III D.** Remsen, D.B. (GA Technologies Inc., San Diego, CA). pp 571 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The 20 MW D-III D (Doublet III reconfigured with a large dee-shaped vacuum vessel) ICRF transmission system is required to deliver 5 MW to each of four launchers for 10 seconds using as basic inputs the 16 1.25 MW power modules. The design presented satisfies this requirement by four sets of power combiners each of which merges the outputs of four 1.25 MW power modules into a single 9 3/16" coaxial line that extends to the torus. The details of how the power is combined, coaxial line size selection, associated instrumentation, feedback control of the phasing, line matching to load and other design features will be presented. A disadvantage of such a system architecture is the severe penalty in both overall system power and spectral content of the launcher array associated with loss of a single power module. A novel switching arrangement will be discussed which shows how a single spare power module can be switched into the circuit to facilitate the servicing of any non-functioning module without significant loss of experimental time.

49145 **Design considerations for a 300 kW 90 MHz amplifier.** Grotz, G. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey). pp 568-570 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A 300 kW 90 MHz grounded grid amplifier was designed and constructed as a driver for two high power amplifiers in the 3 MW power range. The design was computer modeled for evaluation prior to fabrication. The models combined both the cavity and the internal structure of the Eimac 4CW300000G tetrode. The cavities were fabricated in accordance with the model and their performance accurately followed the predicted behavior. The modeling technique is extremely valuable in predicting performance prior to machining metal thus reducing the time and cost of developing complex structures. This technique has been effectively used over the past eighteen years in various applications.

49146 **Design and testing of the BBC tube CQK 650-2 a new high power tetrode for ICRH.** Holm, K.; Egerszegi, L. (Brown Boveri and Cie, Baden). pp 564-567 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The tube CQK 650-2, a high power tetrode, has been specially developed by Brown Boveri for application in generators for fusion research, particularly for ICRH. It was designed for 1,5 MW output power at 30 to 80 MHz. Special emphasis was placed upon good R.F. behaviour and high reliability. Initial tests have shown promising results. The performance at full power and frequency range will be tested in BBC generators for ASDEX at IPP Garching in early 1984.

49147 **Design and fabrication of a surface conversion negative ion source and AN 80 keV pre-accelerator.** Matuk, C.A.; Anderson, O.A.; Berkner, K.H.; Biayi, L.A.; Cooper, W.S.; Ehlers, K.W.; Kwan, J.; Lietzke, K.N.; Maruyama, Y.; Paterson, J.A. (Lawrence Berkeley Laboratory, University of California, Berkeley, CA). pp 560-563 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The design and fabrication of a surface conversion negative ion source and an 80 keV pre-accelerator intended for use as a proof-of-principle demonstration leading to a radiation-hardened 400 keV TFF based beamline for the next generation mirror or tokamak reactor are described in this paper. Experience gained in a previous source and accelerator module was utilized to redefine the overall design and construction for this second generation CW device. The source will provide 1 to 2 amps of H^- for acceleration by a 3 electrode 80 keV preaccelerator. Particular attention was placed on the mounting of the source to the primary high-voltage insulator, the insulator itself, magnet installation, converter shape and construction, cesium injector and exit aperture design, and accelerator construction, with an overall emphasis on serviceability.

49148 **Design and fabrication of circular and rectangular components for electron-cyclotron-resonant heating of Tandem Mirror Experiment-Upgrade.** Felker, B.; Calderon, M.O.; Chargin, A.K.; Christiansen, T.; Coffield, F.E.; Gallagher, N.C.; Lang, D.D.; Pedrotti, L.R.; Rubert, R.R.; Stallard, B.W. (Lawrence Livermore National Lab., Univ. of California, Livermore, CA). pp 554-559 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The electron-cyclotron-resonant heating (ECRH) systems of rectangular waveguides on Tandem Mirror Experiment-Upgrade (TMX-U) operated with a overall efficiency of 50%, each system using a 28-GHz, 200-kW pulsed gyrotron. The authors designed and built four circularwaveguide systems with greater efficiency and greater power-handling capabilities to replace the rectangular waveguides. Two of these circular systems, at the 5-kG second-harmonic heating locations, have a total transmission efficiency of >90%. The two systems at the 10-kG fundamental heating locations have a total transmission efficiency of 80%. The difference in efficiency is due to the additional components required to launch the microwaves in the desired orientation and polarization with respect to magnetic-field lines at the 10-kG points. These systems handle the total power available from each gyrotron but do not have the arcing limitation problem of the rectangular waveguide. Each system requires several complex components. The overall physical layout and the design considerations for the rectangular and circular waveguide components are described here.

49149 **Conceptual design of the TASKA-M neutral beam dumps.** Kleefeldt, K.W.; Muller, R.A. (Kernforschungszentrum Karlsruhe GmbH, Institut fur Reaktorentwicklung, Karlsruhe 1). pp 544-549 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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TASKA-M is a Tandom Mirror Irradiation Facility for fusion technology development. Plasma heating and fueling is primarily achieved by four 90 keV neutral beams in the central cell with a total injected power of approximately 21 MW. In addition there is a neutral beam injector in each of the two anchor regions, providing a particle energy of 73 keV at a total power of 7 MW. The shine through fraction of the injected power must be disposed of by appropriate beam dumps, capable of withstanding the high heat flux, the particle impingement and the thermo-mechanical load. The reference design of the two different types of beam dumps, both utilizing the Hypervapotron cooling technique, are described and the thermal, mechanical and sputtering performance are assessed.

49150 **Comparison of experimental and calculated ICRH antenna parameters.** Braum, F.; Noterdaeme, J.M.; Soll, M. (Max-Placnk-Institut fur Plasmaphysik, EURATOM Association, Garching). pp 539-543 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A strip line antenna similar in dimension to the antenna proposed for heating the ASDEX plasma in the ion cyclotron frequency range was investigated in laboratory experiments (without plasma). The antenna input impedance and resonant frequency (length of the antenna equals $\lambda/4$) were measured. Special emphasis was placed on the influence of additional capacitance configurations placed between the central and return conductors. The measured antenna input impedance values and resonance frequencies were compared with the results obtained with 2-dimensional (2-D) and 3-dimensional (3-D) antenna programs. One main result is that the measured and calculated values for the resonant frequency agree very well for antennae with and without Faraday shield. The agreement is poorer for antennae with additional capacitance structures.

49151 **Characteristics of a long-pulse (30-s), high-power (4-MW) ion source for neutral beam injection.** Menon, M.M.; Barber, G.C.; Combs, S.K.; Dagenhart, W.K.; Gardner, W.L.; Haselton, H.H.; Moeller, J.A.; Ryan, P.M.; Stirling, W.L.; Whealton, J.H. (Oak Ridge National Laboratory, Oak Ridge, TN). pp 534-538 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A quasi-steady-state ion source has been developed for neutral beam injection applications. It is of the duoPIGatron type designed for delivering 50 A of hydrogen ions at 80 keV for 30-s-long pulses. Ion beams of 40 A at 75 keV were extracted for pulse lengths up to 30 s, maintaining excellent optical quality in the beam for the entire pulse duration. The design features and operational characteristics of the ion source are elaborated.

49152 **Persistent resistive regions: multi-strand and multi-monolithic conductors.** Hilai, M.A. (General Dynamics Convair Division, San Diego, California). pp 695-698 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Persistent resistive lengths of the conductor can exist if the composite regions are delaminated or covered with spacers. The presence of these lengths, besides continuously generating joule heating, degrades conductor stability. Delaminated conductor lengths longer than a "critical length" can always lead to the presence of persistent resistive regions. The current study is a continuation of a previous study, in which a single composite conductor was considered.

49153 **Specifying the auxiliary heating system on TFCX.** Metzler, D.H. (Fusion Engineering Design Center/General Electric Company, Oak Ridge National Laboratory, Oak Ridge, Tennessee). pp 672-676 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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This paper reviews the status of heating systems for the TFCX-S (all superconducting coil) and TFCX-H (hybrid coil) options. Three systems were defined: preheating (electron), current drive, and bulk (ion) heating. Application of systems engineering techniques facilitated fruitful discussions of requirements and their impact on equipment between physicists and engineers. A low cost, flexible combination of systems allows plasma experiments using all rf startup and current drive.

49154 **ION cyclotron radio frequency systems and performance on the Tandem Mirror Experiment-Upgrade.** Moore, T.L.; Brooksby, C.A.; Cummins, W.F.; Henderson, A.L.; Karsner, P.G.; Molvik, A.W.; Pedrotti, L.R.; Schofield, D.W. (Lawrence Livermore National Laboratory, University of California, Livermore, California). pp 668-671 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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High power ion cyclotron radio frequency (ICRF) systems are now gaining greater attention than before as prime driver ion heating systems. Lawrence Livermore National Laboratory (LLNL) has installed a 200 kW high frequency (HF) transmitter system on its Tandem Mirror Experiment-Upgrade (TMX-U). This paper describes the system, antenna, controls, and monitoring apparatus. The transmitter operates into a high Q antenna installed in the central cell region of the experiment. It incorporates a dual-port feedback system to automatically adjust the transmitter's output power and allow the maximum consistent with the plasma loading of the antenna. Special techniques have been used to measure, in real-time, the dynamically changing loading values presented by the plasma. From the measurements, the antenna impedance can be optimized for specified plasma density.

49155 **Tritium pellet injection sequences for TFTR.** Houlberg, W.A.; Attenberger, S.E.; Milora, S.L.; Schmidt, G.L.; Singer, C.E. (Oak Ridge Nat. Lab., Oak Ridge, TN). pp 637-641 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Tritium pellet injection into neutral deuterium, beam heated deuterium plasmas in the Tokamak Fusion Test Reactor (TFTR) is shown to be an attractive means of (1) minimizing tritium use per tritium discharge and over a sequence of tritium discharges; (2) greatly reducing the tritium load in the walls, limiters, getters, and cryopanels; (3) maintaining or improving instantaneous neutron production (Q); (4) reducing or eliminating deuterium-tritium (D-T) neutron production in nonoptimized discharges; and (5) generally adding flexibility to the experimental sequences leading to optimal Q operation. Transport analyses of both compression and full-bore TFTR plasmas are used to support the above observations and to provide the basis for a proposed eight-pellet gas gun injector for the 1986 tritium experiments.

49156 **Physical requirements for pellet fueling of mirror reactors.** Hamilton, G.W. (Lawrence Livermore National Laboratory, Univ. of California, Livermore, CA). pp 611-618 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Requirements for pellet fueling of mirror reactors, such as the Mirror Advanced Reactor Study (MARS), have been assessed. To avoid perturbing the MARS centralcell plasma density more than 10%, the authors have determined that the fuel injected per pellet must not exceed 2 x 10^{21} deuterium-tritium (DT) atoms. This implies a maximum radius of 2 mm for each of the frozen DT pellets and a repetition rate of at least 6.2 pellets/s. Furthermore, the required pellet velocity will depend on the plasma density and temperature, including the effects of fusion products such as 3.5-MeV alphas, the shapes of these profiles, and the effectiveness of fueling the center of the plasma by radial diffusion. Under MARS conditions, the velocity requirement for frozen DT pellets will range from 4 to 20 km/s. To minimize this requirement, the authors inject the pellets near the end of the central cell where the plasma radius is reduced by the strong magnetic field and where trapped alphas can be avoided by design of the magnetic field. To meet these fueling objectives, they are looking for new technologies for increasing the pellet speeds. One technology under consideration is the railgun for high-speed acceleration.

49157 A calculation of density profiles in tandem mirrors fueled by pellets. Campbell, R.B.; Gilmore, J.M. (TRW, Redondo Beach, CA). pp 605-610 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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It has been proposed that the central cell fuel ions in a tandem mirror reactor such as MARS or FPD be replenished by the use of high velocity pellets of frozen D-T. The fueling current must replace those ions lost by burnup, diffusion (both radial and axial), and by collisional trapping of ions in the end cell regions. Pellet penetration to only a fraction of the plasma radius is desirable to reduce the required pellet velocity. Central to the issue of whether partial penetration will work for tandem mirrors is that of fueling the plasma by inward radial diffusion. Since axial transport competes with radial transport, one must be careful to deposit particles at a radial location which has adequate axial confinement. Another issue is whether inverted density profiles in the central cell will inhibit the removal of trapped ions in the end cells which is accomplished by induced outward radial transport (drift pumping). To address these issues, the authors modified the LLNL radial transport code TMT to model reactor regime plasmas, fueled by pellets. The source profiles arising from pellet fueling are obtained from existing pellet ablation models. Because inward radial diffusion due to inverted profiles must compete with trapping of central cell ions in the transition region for tandem mirrors, pellets must penetrate fairly far into the plasma. In fact, based on radial calculations, a pellet with a velocity of 10 km/sec cannot sustain the central flux tubes; a velocity more like 100 km/sec will be necessary. They also find that the central cell radial diffusion must exceed classical by about a factor of 100.

49158 ICRH antenna design for the ASDEX and ASDEX UPGRADE tokamaks and for the WVII stellarators. Soll, M.; Wesner, F. (Max-Planck-Institut fur Plasmaphysik, EURATOM Association, Garching). pp 600-604 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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ICRH antennae are being developed for the ASDEX and ASDEX UPGRADE tokamaks and for the W VII A and AS stellarators. The design criteria and evaluation methods are described. For all antennae the electrical and geometrical data are given, the ASDEX antenna being described in more detail.

49159 Hydrogen ARC discharge with bulk cathodes. Itoh, Y.; Sugawara, T. (Toshiba Corp.). pp 597-599 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A bulk cathode proposed to use for a long run operation of magnetic multipole ion source was tested by constructing a rectangular shape plasma generator (18 x 38.6 x 19.7 cm^3). The bulk cathode has a large emission area and volume to prolong its life time against phenomena of evaporation and ion bombardment during arc discharge. In the present experiment, La_2O_3 doped Mo cathodes of disk shape with 10 cm diameter and 7 mm thickness were operated in the emission limited region in producing a hydrogen arc discharge. From the data, an achievable arc efficiency of the generator was roughly estimated to be a half value typically obtained in the ion source with using tungsten filaments as its thermionic cathodes. The use of bulk cathode, therefore, requires a larger arc power in compensation for realizing the long run operation of the ion source.

49160 Feedback-controlled gas feed system for ion sources. Tooker, J.F.; Burell, K.; Kamperschroer, J. (GA Technologies Inc., San Diego, CA). pp 594-596 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The gas feed system, which supplies the gas to the ion sources used on the Doublet III neutral beam injectors was workable, as originally configured, but has a number of inconveniences and difficulties. A new gas system is being developed which is an adaptation of a system used in a variety of applications in tokamak experiments. For each ion source, the system is comprised of four valve assemblies and valve controllers, three for the ion source and one for the neutralizer. Each valve assembly consists of a length of submillimeter tubing, a pressure transducer, and a piezoelectric valve. A flow of 040 Torr-liter/s of hydrogen is achieved through a 400 cm length of 0.53 mm radius tubing. This tubing is plastic to provide the high voltage isolation between the high voltage of the ion source and the valve assemblies which are located at ground potential. The system is interfaced via one of the neutral beam computers and CAMAC to a console in the control room from where the flow is programmed. System description and adaptations will be presented. Performance of the system as operated and adjusted on the bench are presented.

49161 Fault protection of Doublet III Electron Cyclotron Heating System. Remsen, D.B.; Irwin, D.; Lin, S.H.; Moeller, C.; Prater, R. (GA Technologies, San Diego, CA). pp 593 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A description of the successful fault protection systems resulting in reliable protection of both personnel and the equipment used in the Electron Cyclotron Heating experiment on Doublet III will be described. This system uses the voltage of a neutral beam power supply whose polarity has been reversed for gyrotron operation. The conditioned power is then supplied through two Eimac 2062K's in parallel to each of up to ten Varian VGE-8006 cw Gyrotrons for beam widths of up to 5 seconds. Control of each gyrotron is accomplished by switching on and off the gun anode voltage, and this voltage is supplied through a voltage divider in parallel with the gyrotron from cathode to collector. The switch is an inexpensive Thompson 5186, and using this system approach has proved to be cost and operationally effective. The gun anode switch, the modulator regulator, and the crowbar then provide the primary protection elements. The inputs to these circuits, their level, and their origins and time responses will also be described, explaining total operation.

49162 Fabrication of ion source components by electroforming. Schechter, D.E.; Sluss, F. (Oak Ridge National Laboratory, Oak Ridge, TN). pp 589-592 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Several components of the Oak Ridge National Laboratory (ORNL)/Magnetic Fusion Test Facility (MFTF-B) ion source have been fabricated utilizing an electroforming process. A procedure has been developed for enclosing coolant passages in copper components by electro depositing a thick ($\geqq$0.75-mm) layer of copper (electroforming) over the top of grooves machined into the copper component base. Details of the procedure to fabricate acceleration grids and other ion source components are presented.

49163 **Development of a high-heat-flux target for multimegawatt, multisecond neutral beams at ORNL.** Combs, S.K.; Bush, C.E.; Foster, C.A.; Haselton, H.H.; Hayes, P.H.; Menon, M.M.; Milora, S.L.; Moeller, J.A.; Sluss, F.; Tsai, C.C. (Oak Ridge National Laboratory, Oak Ridge, TN). pp 583-588 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A high-heat-flux target has been developed for intercepting multimegawatt, multisecond neutral beam power at the Oak Ridge National Laboratory (ORNL). Water-cooled copper swirl tubes are used for the heat transfer medium; these tubes exhibit an enhancement in burnout heat flux over conventional axial-flow tubes. The target consists of 126 swirl tubes (each 0.95 cm in outside diameter with 0.16-cm-thick walls and ≈ 1 m long) arranged in a V-shape. Two arrays of parallel tubes inclined at an angle α to the beam axis form the V-shape, and this geometry reduces the surface heat flux by a factor of $1/\sin \alpha$ (for the present design, $\alpha = 13°$ and $21°$). In tests with the ORNL long-pulse ion source (13- by 43-cm grid), the target has handled up to 3-MW, 30-s beam pulses with no deleterious effects. The peak power density was estimated at ≈ 15 kW/cm^2 normal to the beam axis (5.4 kW/cm^2 maximum on tube surfaces). The water flow rate through the target was 41.6 L/s (660 gpm) or 0.33 L/s (5.2 gpm) per tube (axial flow velocity = 11.6 m/s). The corresponding pressure drop across the target was 1.14 MPa (165 psi) with an inlet pressure of 1.45 MPa (210 psia). Data are also presented from backup experiments in which individual tubes were heated by a small ion source (10-cm-diam grid) to characterize tube performance. These results suggest that the target should handle peak power densities in the range 25-30 kW/cm^2 normal to the beam axis (≈ 10 kW/cm^2 maximum on tube surfaces) with the present flow parameters. This translates to beam power levels of 5-6 MW for equivalent beam optics.

49164 **Design of mixed-mode microwave launchers for the ELMO Bumpy Torus-Scale (EBT-S) experiment.** Bryan, W.E.; Batchelor, D.B.; Bigelow, T.S.; Kimrey, H.D.; White, T.L. (Union Carbide Corporation Nuclear Division, Oak Ridge, Tennessee). pp 579-582 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Direct core plasma electron cyclotron heating (ECH) at the fundamental resonance in the ELMO Bumpy Torus-Scale (EBT-S) device has historically been limited by the right-hand cutoff of the 28-GHz extraordinary mode. The cutoff is encountered as a result of propagation from the present geometry - mirror midplane launch at low magnetic field. Access to the fundamental resonance occurs primarily through mixedmode delivery and subsequent reflection and mode conversion throughout the torus. Extraordinary mode energy that does eventually propagate from the high magnetic-field region of the mirror coil throat experiences the theoretical advantage of essentially 100% coupling with the plasma at the fundamental resonance. Batchelor et al. have explored the theoretical increases in coupling efficiency proposed by high-field launch of microwave energy toward the fundamental resonance. Favorable results in early high-field launching experiments have initiated the current microwave development program with the goal of improved plasma parameters through the implementation of high-field or throat launching.

49165 **ECRHPSS local control program.** Campbell, L.; Movva, R.; Seligmann, D. (GA Technologies Inc., San Diego, CA). pp 321-323 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A local control program was required to demonstrate the performance of the power supplies built by the Universal Voltronics Corporation for the electron cyclotron resonance heating power supply (ECRHPSS) which is a part of the Large Tandem Mirror Fusion Test Facility (MFTF-B) at Lawrence Livermore National Laboratory (LLNL). The ECRHPSS local control program performs two functions: 1) report on and clear faults and interlocks occurring through the system 2) monitor control of up to eight modulator regulators (mod/reg), and one transient compensation capacitor bank (TCC).

49166 **A stand alone computer system to aid the development of mirror fusion test facility RF heating systems.** Thomas, R.A. (Lawrence Livermore National Laboratory, Livermore, CA). pp 362-366 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The Mirror Fusion Test Facility (MFTF-B) control system architecture requires the Supervisory Control and Diagnostic System (SCDS) to communicate with a LSI-11 Local Control Computer (LCC) that in turn communicates via a fiber optic link to CAMAC based control hardware located near the machine. In many cases, the control hardware is very complex and requires a sizable development effort prior to being integrated into the overall MFTF-B system. One such effort was the development of the Electron Cyclotron Resonance Heating (ECRH) system. It became clear that a stand alone computer system was needed to simulate the functions of SCDS. This paper describes the hardware and software necessary to implement the SCDS Simulation Computer (SSC). It consists of a Digital Equipment Corporation (DEC) LSI-11 computer and a Winchester/Floppy disk operating under the DEC RT-11 operating system. All application software for MFTF-B is programmed in PASCAL, which allowed us to adapt procedures originally written for SCDS to the SSC. This nearly identical software interface means that software written during the equipment development will be useful to the SCDS programmers in the integration phase.

49167 **A high performance DC to 1 MHz analog fiber-optic telemetry link.** Meixler, L.D. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey). pp 354-357 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The subject requirement is for a wide bandwidth, accurate telemetry link, with high voltage isolation capability, which can operate over a 25°C to 55°C temperature range for the data collection and fault detection applications associated with the TFTR Neutral Beam System. Most commercially available analog links are based either on the voltage to frequency-frequency to voltage conversion technique, or on techniques which modulate light intensity on the fiber-optic link in proportion to the signal amplitude. The latter system is technically flawed in that any variations in the optical system due to changing cables, LED degradation, etc. affect the signal. The former requires very high frequency carriers to accommodate the zero to 1.0 MHz baseband signal, consequently, any small frequency drift either on the transmitting or receiving end causes a significant error in the received signal. Described in this paper, is a data link, which avoids the above by encoding the data into a digital format and then transmitting the digitized data over the optical system. The system requirements for the Neutral Beam Optical Data System are summarized.

49168 **A distributed control system for lower hybrid RF experiments on the Alcator C Tokamak.** Bredin, C.W. (Plasma Fusion Center, Massachusetts, Institute of Technology, Cambridge, MA). pp 350-353 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A distributed control system has been designed which provides programmable on/off control of four independent 1 MW, 4.6 GHz microwave transmitter installations for RF heating and current drive experiments on the Alcator C tokamak. It also provides the capability to inhibit one or all transmitters upon generation of various fault conditions. The control system consists of a Control/Display Unit (CDU) and four Remote Units. The CDU permits functional control of the system by an operator via its front panel and communicates with the Remote Units by means of a serial data bus, system clock, and three "party line" discrete signal interfaces. The two individually programmable system control parameters are the length of a delay between an initial pulse and the onset of RF, and the length of the RF pulse. Upon receipt of an initial trigger pulse, a Remote Unit will "count down" its programmed delay; enable the transmitter power amplifier (PA) high voltage; and, approximately one millisecond after the high voltage, enable the RF drive to the PA for its programmed length. A major design consideration for this system was flexibility: it is presently capable of providing one hundred second pulse lengths, and with the addition of a computer interface card and some modification to the Remote Units, the system could be readily adapted to provide real-time, closedloop, analog RF power control for up to fifteen transmitter installations on a long-pulse successor to Alcator C. A prototype CDU and one Remote Unit have been constructed and subjected to bench and in-situ system acceptance testing. The system was then used to operate a one megawatt transmitter installation. The control system is now in the production phase. This paper will address systems requirements, make/ buy tradeoff issues, design considerations, implementation, system flexibility/expansion, acceptance test results, and performance evaluation for the control system.

49169 **A water flow calorimeter calibration system.** Ullrich, F.T. (Princeton University, Plasma Physics Laboratory, P.O. Box 451, Princeton, New Jersey). pp 367-369 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Neutral beam systems are instrumented by several water flow calorimeter systems, and some means is needed to verify the accuracy of such systems and diagnose their failures. This report describes a calibration system for these calorimeters. The calibrator consists of two 24 kilowatt circulation water heaters, with associated controls and instrumentation. The unit can supply power from 0 to 48 kW in five coarse steps and one fine range. Energy is controlled by varying the power and the time of operation of the heaters. The power is measured by means of precision power transducers, and the energy is measured by integrating the power with respect to time. The accuracy of the energy measurement is better than 0.5% when the power supplied is near full scale, and the energy resolution is better than 1 kilojoule. The maximum energy delivered is approximately 50 megajoules. The calorimetry loop to be calibrated is opened, and the calibrator is put in series with the calorimeter heat source. The calorimeter is then operated in its normal fashion, with the calibrator used as the heat source. The calibrator can also be used in a stand alone mode to calibrate calorimeter sensors removed from systems.

49170 **Archiving Doublet III neutral beam data for offline analysis and access.** Lertique, L.P. (GA Technologies Inc., San Diego, CA). pp 380-381 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The neutral beam injectors at GA Technologies operate with a short time interval between pulses. This is intended to keep the injectors conditioned for optimum efficiency. The time required is affected by, but not restricted to, the time required to acquire diagnostic data. The short interval between pulses restricts any indepth online analysis of the data acquired. The data is archived to tape and transferred to the computer in the GA Technologies User Service Center for later in-depth offline analysis. The archived tapes are constructed with the same format as the Doublet III Data Acquisition System archived data tapes. This procedure allows the neutral beam data to be archived on the computer in the Users Service Center with the same processing programs and analyzed with any general analysis programs used on the Doublet III Data Acquisition archived tapes.

49171 **The TRIO-01 experiment: in-situ tritium recovery results.** Clemmer, R.G.; Bate, L.C.; Billone, M.C.; Clemmer, E.D.; Dudley, I.T.; Dyer, F.F.; Finn, P.A.; Fischer, P.W.; Misra, B.; Watson, J.S. (Argonne National Laboratory, Argonne, IL). pp 167-171 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The TRIO-01 experiment was designed to test in-situ tritium recovery and heat transfer performance of a candidate solid breeder, γ-LiAlO$_2$. The results showed that nearly all the tritium generated was recovered. Only <0.1 wppm tritium remained in the solid after irradiation testing. The heat transfer performance showed that temperature profiles can be effectively controlled.

49172 **The design, fabrication and testing of the gas analysis system for the tritium recovery experiment, TRIO-01.** Finn, P.A.; Bowers, D.L.; Clemmer, E.D.; Clemmer, R.G.; Graczyk, D.G.; Homa, M.I.; Pappas, G.; Reedy, G.T.; Slawecki, M.A. (Argonne National Laboratory, Argonne, IL). pp 163-166 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The tritium recovery experiment, TRIO-01, required a gas analysis system which detected the form of tritium, the amount of tritium (differential and integral), and the presence and amount of other radioactive species. The system had to handle all contingencies and function for months at a time; unattended during weekend operation. The designed system, described herein, consisted of a train of components which could be grouped as desired to match tritium release behavior.

49173 **TFTR hardwired interlock system for personnel access control.** Shobert, G.F. (Plasma Physics Lab., Princeton Univ., Princeton, NJ). pp 1238-1243 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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This system is responsible for controlling access independently into the Tokamak Test Cell, the Test Cell Basement and the Data Acquisition Rooms (DARM's) of TFTR. This paper will discuss the operational and safety requirements for TFTR access control and how they have been satisfied by the system that has been implemented.

49174 **Prompt radiation environment for the TFTR Q=1 demonstration.** Kolibal, J.G.; Ku, L.P. (Princeton Plasma Physics Laboratory, Princeton, NJ). pp 1274-1278 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The tokamak fusion test reactor (TFTR) which has been built at Princeton University will soon be operating with a deuterium-deuterium (DD) fuel cycle, and it is anticipated that the use of deuterium-tritium (DT) fuel will occur late in 1986 in order to demonstrate that the fusion energy output can achieve breakeven (Q=1). From the beginning it was evident that the maintenance and operation of the machine and its environment would be conditional upon the expectable radiation levels associated with DD and DT pulsing. Although much effort had been devoted in the past to assessing the magnitude of the problem, because of the size of the task, there had never been any large scale global radiation transport analyses done for the TFTR in the absence of an igloo shield around the tokamak. Furthermore, because of computational limitations, previous global studies could not represent as much of the detail of the machine and its environment as would be desirable. The purpose of this study was to provide a final review of the global prompt radiation environment on TFTR, updating the changes which had been made in the engineering design of the machine, and providing a thorough review of the basis upon which many of the other analyses rested.

49175 **Safety comparison of d-d and d-t fueled fusion reactors.** Dabiri, A.E.; Gurol, H. (Science Applications Inc., La Jolla, CA). pp 1279-1282 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The purpose of this paper is to compare the safety of d-d and d-t fueled fusion reactors. Issues related to public (as opposed to personnel) safety are considered only. The reactor concepts considered are: tokamaks, tandem mirror reactors (TMRs) and compact reversed field pinch reactors (CRFPRs). It is found that the consequences of activated coolant corrosion product and activated structure release are similar for d-d and d-t reactors. The major safety related difference between the two fuel cycles is the much lower tritium inventory of d-d reactors and the absence of lithium compounds.

49176 **Safety assessment of the MARS tandem mirror reactor.** Gurol, H.; Dabiri, A.E. (Science Applications Inc., La Jolla, CA). pp 1283-1286 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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In this study, the safety of the MARS tandem mirror reactor is assessed. Only prompt public consequences are considered. Plant boundary doses are calculated at 1000 m. The major radioactive inventories are due to the first-wall/blanket structure, coolant, and tritium. The conclusions are summarized below: (1) Mechanisms and conditions for releasing large fractions of the radioactive HT-9 structure were not found. The maximum dose is below 0.1 rem, since only oxides of molybdenum are expected to be released. (2) Because the activated corrosion products are filtered, most of the coolant activity is due to the LiPb. A LOCA can result in large doses only if this activity can be transported outside the reactor containment building. Most of the LiPb is expected to solidify. Aerosols that are produced will likely plate out on surfaces or settle. (3) Various tritium accident scenarios were considered. Release of all the tritium in the reactor building (53 g) leads to a dose of 21 rem.

49177 **Safety review and approval process for the TFTR.** Levine, J.D.; Howe, H.J.; Howe, K.E. (Envirosphere Company, Forrestal Campus, Princeton, NJ). pp 1287-1290 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The design, construction, and operation of the Tokamak Fusion Test Reactor (TFTR) has undergone an extensive safety and enviromental analysis involving Princeton Plasma Physics Laboratory (PPPL), the U.S. Department of Energy (DOE), the Ebasco/Grumman Industrial Subcontractor Team, and other organizations. This analysis, which is continuing during the TFTR operational phase, has been facilitated by the preparation, review and approval of several documents, including an Environmental Statement (Draft and Final), a Preliminary Safety Analysis Report (PSAR), a Final Safety Analysis Report (FSAR), Operations Safety Requirements (OSRs) and Safety Requirements (SRs), and various Operating and Maintenance Manuals. Through TFTR Safety Group participation in formal system design evaluations, change control boards, and reviews of project procurement and installation documentation, the TFTR Management Configuration Control System assures that all aspects of the project, including proposed design, installation and operational changes, receive prompt and thorough safety analyses. These efforts will continue as the TFTR Program moves into the neutral beam and D-T operational phases. The safety review and approval experience that has been acquired on the TFTR Project should serve as a foundation for similar efforts on future fusion devices.

49178 **Tritium systems for the tokamak fusion core experiment, TFCX.** Finn, P.A. (Argonne National Laboratory, Argonne, IL). pp 1193-1197 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Tritium systems, tritium needs and possible tritium release scenarios were assessed for a TFCX class of device, 250 MW, 2 x 10^5 s of burn, with burn times from 20 s to 300 s. On-site and off-site, continuous and batch processing modes were considered. A reference case, batch processing was developed which fulfills the requirements for plasma physics experiments.

49179 **Tritium systems for the mirror upgrade MFTF-αT.** Finn, P.A. (Argonne National Laboratory, Argonne, IL). pp 1198-1202 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The tritium systems and the tritium needed for MFTF-αT were assessed. This mirror reactor produces 20 MW of power, has 10% availability and uses tritium positive neutral beams with 20-30% total gas efficiency as fuelers. The two burn times considered were 10 h and 100 h. A reference processing case was developed including types, sizes, and cost of units.

49180 **Performance tests of the emergency room air tritium removal system for the Tritium Systems Test Assembly.** Carlson, R.V. (Los Alamos National Laboratory, Los Alamos, NM). pp 1179 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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One of the major safety components of the Tritium Systems Test Assembly (TSTA) is the Emergency Tritium Cleanup System (ETC). It will remove tritium from the air of the tritium handling areas at TSTA should an accidental release occur. Measurements have been made on the efficiency of the ETC to remove hydrogen isotopes from room air. The ETC removes tritium from room air by the catalytic conversion of gaseous tritium (T_2) to the oxide form (T_2O) and then subsequent removal of the water by condensation and further drying by passing the air stream through molecular sieve. The major components of the system are: Compressors, which collect room air and compress it to 50 psia; Catalyst bed, which converts hydrogen isotopes to water and is operated at approximately 300°F; Condenser, which cools the process air to 35°F condensing water and reducing the water concentration to approximately 2000 ppm; Water Storage Tanks, in which the condensed water is collected; and Molecular Sieve Beds, which dry the air to a moisture level of about ppm water. The temperature of the catalyst bed is maintained by the heat of compression from the compressor. During the initial warm up of the bed, hydrogen can be added to provide local heating on the catalyst surface thus maintaining the efficient conversion of tritium gas to the water form. Hydrogen can also be added to the input of the ETC to provide a dilution of the tritium to maintain a higher conversion efficiency. In addition, water can be added between molecular sieve beds to provide a dilution and more efficient removal of tritiated water by the molecular sieve. The following parameters were determined: catalyst bed heat up time and efficiency to convert hydrogen isotopes to the oxide form; water removal efficiency of the refrigerated dryer and molecular sieve beds; and the effect hydrogen and water addition on the efficiency of hydrogen removal.

49181 **Subsystem cost data for the Tritium Systems Test Assembly.** Bartlit, J.R.; Anderson, J.L.; Rexroth, V.G. (Los Alamos National Laboratory, Los Alamos, NM). pp 1186-1192 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Details of subsystem costs are among the questions most frequently asked about the $14.4 million Tritium Systems Test Assembly (TSTA) at Los Alamos National Laboratory. This paper presents a breakdown of cost components for each of the 20 major subsystems of TSTA. Also included are details to aid in adjusting the costs to other years, contracting conditions, or system sizes.

49182 **Accidental tritium release from solid breeding blankets.** Holland, D.F.; Merrill, B.J. (EG & G Idaho, Inc., Idaho Falls, ID). pp 1138-1142 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Vulnerability of tritium in a solid breeding material has been determined for accidents involving failure of the barrier between the blanket and reactor building. Two breeding materials were analyzed, lithium aluminate and lithium oxide. Accident scenarios included either continuation or termination of the blanket cooling and helium purge flow. The results showed that with the purge flow continued, tritium in lithium oxide is more vulnerable than in lithium aluminate. As the blanket cools after reactor shutdown, tritium is desorbed from the lithium oxide because of its temperature dependent solubility. In additon, the diffusion rate in the solid remains high enough for tritium release, is limited by diffusion along purge channels to the blanket boundary. For this case, only a small fraction of tritium is released from either lithium oxide or lithium aluminate. Again, the desorbed tritium from the lithium oxide results in a higher release from this material. Materials properties, including possible phase changes in lithium oxide, are the primary source of uncertainty in these calculations.

49183 Fusion reactor safety issues and the U.S. safety program. Crocker, J.G. (EG & G Idaho, Inc., Idaho Falls, ID). pp 503 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Based on current fusion reactor conceptual designs and fusion program development plans, the first generation of fusion reactors will produce power by fusion of deuterium (D) and tritium (T). The principal safety issues with D-T burning fusion reactors involve the presence of significant inventories of radioactivity distributed in the nuclear island. These inventories consist of (1) tritium which must be burned and bred in a fusion reactor at a rate of approximately 0.13Kg per day per GW(th), and (2) activation products that are produced in reactor structural materials, coolant streams and the reactor building atmosphere. The inventory of activation products is approximately one GCi per GW(th). Although a minimum quantity of tritium must be burned to produce a given power level, the total tritium inventory can be minimized by selection of reactor materials and coolant and by operating practices. Likewise, the inventory of activation products and their half-lives can be significantly reduced by selection of structural material.

49184 Structured flowcharts for control logic specification in the Tritium Systems Test Assembly. Nielson, C.W.; Claborn, G.W. (Los Alamos National Laboratory, Los Alamos, NM). pp 414 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The Tritium Systems Test Assembly (TSTA) contains several subsystems employing sophisticated chemical and physical processes to purify, transport, and capture the isotopes of hydrogen. The ultimate responsibility for the correct and safe operation of these subsystems lies with their designers. However, the logic is implemented in a computer system with program control. A means to insure unambiguous specification of the control logic in a form understandable to both the non-programming designers and the software staff was required. The computer programs are written in RATFOR, a language providing clear control structures and powerful symbol definition facilities. However, the actual code was considered unsatisfactory as a means of primary specification by the non-programming designers. On the other hand, simple English language descriptions of the desired behavior were not precise enough to insure correctness. Experimentation with traditional flowcharts proved that they were more difficult to follow than the RATFOR code. On the other hand, the use of structured flowcharts derived from those introduced by Nassi and Shneidermanl have proven to be very powerful. Using simple geometric forms for the basic control structures such as loops and conditional tests, and by using expansion rather than connection as the means of reducing any flowchart to a single page, a specification that is both understandable and precise has been obtained. A computer code automates the production and modification of these flowcharts. Combining these flowcharts with primitive subroutines which hide most of the details of control implementation has provided an effective medium for algorithm specification and validation. Examples of the flowcharts and the language used to specify them will be given.

49185 Fusion Safety Data Base /SUP a/ . Laats, E.T.; Hardy, H.A. (EG & G Idaho, Inc., Idaho Falls, ID). pp 504-506 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The purpose of this Fusion Safety Data Base Program is to provide a repository of data for the design and development of safe commercial fusion reactors. The program is sponsored by the United States Department of Energy (DOE), Office of Fusion Energy. The function of the program is to collect, examine, permanently store, and make available the safety data to the entire U.S. magnetic-fusion energy community. The sources of data will include domestic and foreign fusion reactor safety-related research programs. Any participant in the DOE Program may use the Data Base Program from his terminal through "user friendly" dialog and can view the contents in the form of text, tables, graphs, or system diagrams.

49186 Tritium related safety considerations for Mirror Upgrades. Ghose, S.K. (Lawrence Livermore National Laboratory, University of California, Livermore, California). pp 507-511 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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One of the primary objectives of the MFTF-B upgrades is to demonstrate the technology of tritium breeding in a reactor-like configuration. This requires use and processing of tritium, involving an inventory of several hundred grams at the plant. This paper reviews the results of a preliminary assessment of the radiation hazard associated with the handling of tritium. The radiation dose consequences due to tritium release from normal operation and due to postulated accidents on plant personnel and the public were assessed. Maximum credible (probability $<10^{-3}$, but $>10^{-7}$/yr) accidental releases were estimated to be 10 gm in the reactor building and 100 gm in the tritium-processing building. Higher probability ($>10^{-3}$/yr) accidents or component failures would result in much smaller releases. In the reactor building, the most severe accident would result from the rupture of a plasma exhaust duct from the end cell or the tritium feed pipe to the neutral beam injector, accompanied by a fire. In the tritium processing building, the most severe accident would be the rupture of the Isotope Separation System (ISS) distillation columns and vacuum jackets accompanied by a fire. The radiation dose at the site boundary (i.e. to the public) due to normal operation is estimated to be at least an order of magnitude below the DOE suggested value (10 mR/yr). The integrated radiation dose at the site boundary due to an accidental release is also estimated to be well below the DOE suggested value (5 Rem). The dose commitment to the worker under any situation can be maintained well below the DOE suggested values by adopting appropriate operating procedures.

49187 Risk assessment of computer-controlled safety systems for fusion reactors. Fryer, M.O.; Bruske, S.Z. (EG & G Idaho, Inc., Idaho Fall, ID). pp 512-515 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The complexity of fusion reactor systems and the need to display, analyze, and react promptly to large amounts of information during reactor operation will require a number of safety systems in the fusion facilities to be computer controlled. Computer software, therefore, must be included in the reactor safety analyses. Unfortunately, the science of integrating computer software into safety analyses is in its infancy. Combined plant hardware and computer software systems are often treated by making simple assumptions about software performance. This method is not acceptable for assessing risks in the complex fusion systems, and a new technique for risk assessment of combined plant hardware and computer software systems has been developed. This technique is an extension of the traditional fault tree analysis and uses structured flow charts of the software in a manner analogous to wiring or piping diagrams of hardware. The software logic determines the form of much of the fault tree.

49188 **Thermal and structural design of a compact circular direct converter for MARS.** Luzzi, T.; Erickson, J. (Grumman Aerospace Co., Bethpage, NY). pp 1883-1887 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The MARS direct converter is circular and much smaller than the interim configuration. This paper presents the details of the major components including component sizes, method of segmentation for ease of installation and maintenance, supports and coolant water piping. A material screening study of nine candidate materials was conducted. Two of the materials satisfy the conflicting requirements of high plasma heat loads with high coolant outlet temperature needed for steam generation. A point design was chosen specifying the coolant channel size and arrangement within the inner and outer collector sectors and halo scraper. Performance parameters including coolant pumping power, flow rate, pressure, coolant inlet and outlet temperature, and material temperature and stresses are presented. Material sputtering of the converter elements is discussed.

49189 **NOVA laser facility for inertial confinement fusion.** Simmons, W.W. (Lawrence Livermore National Laboratory, Livermore, CA). pp 1381-1385 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The NOVA laser fusion research facility, currently under construction at Lawrence Livermore National Laboratory, will provide researchers with powerful new tools for the study of nuclear weapons physics and inertial confinement fusion. The NOVA laser system consists of ten large (74 cm diameter) beams, focused and aligned precisely so that their combined energy is brought to bear for a small fraction of a second on a tiny target containing thermonuclear fuel (deuterium and tritium). The ultimate goal of the LLNL inertial confinement fusion program is to produce fusion microexplosions that release several hundred times the energy that the laser delivers to the target. Such an achievement would make inertial confinement fusion attractive for military and civilian applications. The NOVA laser consists of ten beams, capable of concentrating 100 to 150 kJ of energy (in 3 ns) and 100 to 150 TW of power (in 100 ps) on experimental targets by 1985. NOVA will also be capable of frequency converting the fundamental laser wavelength (1.05 μm) to its second (0.525 μm) or third (0.35 μm) harmonic. This additional capability (80 to 120 kJ at 0.525 μm, 40 to 70 kJ at 0.35 μm) was approved by the U.S. Department of Energy (DOE) in April 1982. These shorter wavelengths are much more favorable for ICF target physics. Current construction status of the NOVA facility, intended for completion in the autumn of 1984, will be presented.

49190 **Engineering of Particle Beam Fusion Accelerator II.** Cook, D.L.; Barr, G.W.; Furaus, J.P. (Sandia National Laboratory, Albuquerque, NM). pp 1386-1391 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The Particle Beam Fusion Accelerator II (PBFAII) is presently under construction at Sandia National Laboratories. PBFA-II contains 36 individual accelerators configured in a stacked radial geometry and synchronized to provide 3.5 MJ of energy in a single 40 ns wide 100 TW power pulse to the load. This R & D construction project is scheduled in a fast track mode with final design of the accelerator components occurring in parallel with the construction of the laboratory building and the accelerator tank. PBFA-II is scheduled to become operational in January 1986 with its first multi-module shot into an experimental load.

49191 **OMEGA: A short-wavelength laser for fusion experiments.** Soures, J. (University of Rochester, Laboratory for Laser Energetics, Rochester, New York). pp 1392-1397 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The OMEGA, Nd:glass laser facility was constructed for the purpose of investigating the feasibility of directdrive laser fusion. With 24 beams producing a total energy of 4 kJ or a peak power of 12 TW, OMEGA is capable of nearly uniform illumination of spherical targets. Six of the OMEGA beams have recently been converted to shortwavelength operation (351 nm). In this paper, the authors discuss details of the system design and performance, with particular emphasis on the frequency-conversion system and multiwavelength diagnostic system.

49192 **Uniformity analysis for a direct-drive laser fusion reactor.** Lund, L.D.; Goldman, L.M.; Skupsy, S. pp 1398-1401 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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There are two fundamental approaches to inertial fusion: direct- and indirect-drive. In the indirect method, the driver, either laser or ion beam, is first converted to x-rays and the x-rays are used to implode the final target. In the second approach, the beams irradiate and ablate the target directly. For direct-drive a very high degree of uniformity in the illumination on the target is required if high performance is to be achieved. In this paper the authors show the results of an analysis of the uniformity for a direct-drive reactor using 20, 32, 60, or 96 beams. Several of these options achieve less than the 1% nonuniformity that is required. These options are considered for the cases where the solid angle fraction of the beam ports is 2% and 8%. The analysis is facilitated by separating the contributions due to the geometrical effects related to the number and orientation of the beams from those due to the spatial profile of the individual beams. Emphasis is placed on the wavelength of the nonuniformities, as the shorter wavelength nonuniformities are more easily smoothed by thermal conduction within the target. The analysis demonstrates that the longer wavelengths can be minimized by suitable choices of geometry and by maintaining beam balance, whereas the shorter wavelength nonuniformities can be reduced by optimizing parameters such as the focal position and the spatial intensity profile of each beam. The tolerances required for beamtobeam energy balance are discussed.

49193 **Novette Facility: Activation and preliminary experimental results.** Manes, K.R. (Lawrence Livermore National Laboratory, Livermore, CA). pp 1402-1408 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The construction and performance of the Novette Laser/Target interaction system are described. When an extremely intense beam of laser light strikes a microscopic target containing deuterium-tritium fuel, it can generate an energetic plasma by imploding the fuel capsule. The rapid rise in temperature and density in the inertially confined D-T fuel produces a tiny but powerful thermonuclear explosion. The Lawrence Livermore National Laboratory has been the scene of active inertial confinement fusion, or ICF, research since 1969, with the goal of eventually achieving usable power from a future ICF reactor. As recently as three years ago, controversy raged over the relative effectiveness of different lasers as fusion drivers. Today the preponderance of evidence favors a green to near-ultraviolet laser and we have assembled such a source for multikilojoule target experiments. The Novette laser-target interaction system fulfills this requirement by combining salvaged components from earlier LLNL lasers such as SHIVA, once the world's most powerful, with parts borrowed from Nova, a 100 TW device scheduled for completion in late 1984.

49194 **Mechanical construction of the Nova laser.** Hurley, C.A.; Frick, F.; Martos, A.; Patton, H. (Lawrence Livermore National Laboratory, Livermore, CA). pp 1409-1415 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The Nova laser system for Inertial Confinement Fusion studies at Lawrence Livermore National Laboratory is under construction and will be completed October 1984 with first operations scheduled for 1985. This system is the largest precision opto-mechanical engineering system ever built! Major engineering and subsystems are mechanical, optical, and electrical power. A series of system technologies include alignment, diagnostics, target, frequency conversion, and controls. This paper only discusses the mechanical system.

49195 **Monte Carlo modeling of ICRF ring formation in EBT reactors.** Driemeyer, D.E.; Kashuba, R.J. (McDonell-Douglas Astronautics Co., St. Louis, MO). pp 1436-1439 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Past work on ion ring stabilized EBT reactor configurations has identified a favorable power balance for ion ring operation. For core betas in excess of 5%, a window in parameter space consistent with presently known ring/core stability theories is predicted that requires less recirculating power than for equivalent beta electron rings. To determine the feasibility of establishing an ion population within this window utilizing a combination of beam injection and RF heating, a Monte Carlo computer code has been developed which simulates the behavior of a group of beam injected particles under the influence of coulomb collision, charge exchange, and RF heating operators. The Monte Carlo approach was selected in order to retain both configuration (r, z) and velocity (v, v) space information and to allow for the future incorporation of superadiabatic effects so that axis-encircling ring configurations might be investigated. This paper discusses the general aspects of the model and outlines the algorithms which are used to represent the various collision operators. Preliminary results are also presented to illustrate the use of the code and to highlight initially promising indications relative to ion ring formation.

49196 **The twin-fall concept for an ICF chamber.** Stubbing, J.; Adams, B.; Choi, C.; Miley, G.; Ragheb, M. (Fusion Studies Laboratory, University of Illinois, Urbana, Illinois). pp 1901-1905 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A twin-fall concept, with a thin sacrificial inner fall and a thick outer annular fall, is proposed for use for energy conversion and structural protection of an advanced-fuel inertial confinement fusion (ICF) reactor. This scheme takes full advantage of the unique D-T ignited D-D-^{3}He target yield, which is primarily in short range irradiation. A compact chamber, radius of 3 m, is achieved, giving a high energy density, low chamber costs, and effective heavy ion beam driver focusing. The reactor concept is named LOTRIT to emphasize the minimum tritium inventory due to combination of the target design and a selection of liquid lead as a chamber working fluid.

49197 **Pulse Star Inertial Confinement Fusion Reactor: Heat transfer loop and balance-of-plant considerations.** McDowell, M.W.; Blink, J.A.; Curlander, K.A. (Energy Technology Engineering Center, Rockwell International, Canoga Park, CA). pp 1833-1838 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A conceptual heat transfer loop and balance-of-plant design for the Pulse Star Inertial Confinement Fusion Reactor has been investigated and the results are presented. The Pulse Star reaction vessel, a perforated steel bell jar about11 m in diameter, is immersed in $Li_{17}Pb_{83}$ coolant, which flows through the perforations and forms a 1.5-m-thick plenum of droplets around a 8-m-diameter inner chamber. The bell jar and associated pumps, piping, and steam generators are contained within a 17-m-diameter pool of $Li_{17}Pb_{83}$ coolant to minimize structural requirements and occupied space, resulting in reduced cost. Four parallel heat transfer loops, each with a flow rate of 5.5 m^3/s, are necessary to transfer 3300 MWt of power. Liquid metal is pumped to the top of the pool, where it flows downward through eight vertical steam generators. Double-walled tubes are used in the steam generators to assure tritium containment without intermediate heat transfer loops. Each pump is a mixed flow type and has a required NPSH of 3.4 m, a speed of 278 rpm, and an impeller diameter of 1.2 m. The steam generator design was optimized by finding the most cost-effective combination of heat exchanger area and pumping power. The design minimizes the total cost (heat exchanger area plus pumping) for the plant lifetime. The power required for the pumps is 36 MWe. Each resulting steam generator is 12 m high and 1.6 m in diameter, with 2360 tubes. The steam generators and pumps fit easily in the pool between the reactor chamber and the pool wall.

49198 **Nova power systems: status and operating experience.** Witham, K.; Gritton, D.; Holloway, R.W.; Merritt, B.T.; Oicles, J.A.; Smart, J. (Lawrence Livermore Nat. Laboratory, Livermore, CA). pp 2065-2069 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The Nova Laser is a 100KJ, 100 TW, 10 beam Nd Laser in construction at Lawrence Livermore Laboratory and is being built to be an experimental facility for laser fusion. The world's largest peak power laser, Nova is the latest in a series of increasingly large lasers and is the culmination of over 10 years of development of solid state laser systems. In preparation for Nova and in order to fill a gap in experimental data, two arms of Nova have been installed in the Novette facility and have been in operation for over a year. This paper describes the pulse power systems that are used in these two lasers; the status and the operating experiences. The pulsed power system for the Nova Laser is comprised of several distinct technology areas. The large capacitor banks for driving flashlamps that excite the laser glass is one area, the fast pulsers that drive pockels cell shutters is another area, and the control system for the pulsed power is a third. This paper discusses the capacitor banks and control systems.

49199 **An overview of the national inertial fusion program.** Bixler, D.N. (Office of Inertial Fusion, U.S. Department of Energy). pp 932-936 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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From early on, the inertial fusion concept was recognized as a viable candidate for energy production. However, because of its potential military applications, inertial fusion gained support as a weaponsrelated program. While the magnetic fusion program was declassified and made the subject of international cooperative efforts, much of the inertial fusion program remained, as it is today, classified as secret. Nonetheless, the concept remains a viable prospect for energy production, and considerable progress has been made over the years toward understanding the potential and problems involved with application of inertial fusion principles. The program evolved from a small discretionary effort in the early 1960's to a $170M per year R & D program under the auspices of the DOE's Office of Inertial Fusion in FY 1984.

49200 **Laser drivers for inertial confinement fusion.** Holzrichter, J.F. (Lawrence Livermore National Laboratory, Livermore, CA). pp 937 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Inertial Confinement Fusion (ICF) is the technology that we are developing to access the vast stored energy potential of deuterium fuel located in the world's water supply. This form of fusion is accomplished by compressing and heating small volumes of D-T fuel to very high temperatures (greater than 100M °C) and to very high densities (greater than 1000 times the normal liquid density). Under these fuel conditions, a thermonuclear reaction can occur, leading to a net energy release compared to the energy used to heat the fuel initially. To accomplish the condition where fusion reactions begin, effective drivers are required. These are lasers or particle beam accelerators which can provide greater than 10^{14}W/cm^2 over millimeter scale targets with an appropriately programmed intensity vs time. At present, we are using research lasers to obtain an understanding of the physics and engineering of fuel compression.

49201 **Development of CO_2 and KrF gas lasers as drivers for inertial confinement fusion.** Rockwood, S.D. (Los Alamos National Laboratory, Los Alamos, NM). pp 938-942 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Achieving high gain performance from inertial confinement fusion targets requires drivers capable of delivering several megajoules of energy to the target at power densities in excess of 100 TW/cm^2. At the present time the cost of such a driver is prohibitive. Several development efforts are now underway on both solid state and gas phase lasers that have the objective of finding major cost reductions through new systems architectures. This paper reviews the present status of two gas laser systems: the carbon dioxide laser and the krypton fluoride laser.

49202 **Light ion fusion.** VanDevender, J.P. (Sandia National Laboratories, Albuquerque, NM). pp 943-947 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The Inertial Confinement Fusion Program with Light Ion Drivers is developing high intensity ion beam driver technology on PBFA I and will apply that technology to study implosion hydrodynamics of small fuel masses on PBFA II. Power concentration is the key issue. The research on beam production and focusing is interpreted to give guidelines for future research in the ICF Program. Recent progress is reviewed briefly and the impact of recently discovered problems of ion impurities and beam energy spread are discussed. The lithium ion option for PBFA II has been chosen and the first PBFA II diode will be the Applied-B diode.

49203 **Heavy ion drivers for inertial confinement fusion.** Keefe, D. (Accelerator and Fusion Research Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California). pp 948-951 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The advantages of heavy ion beams as a way of delivering the needed energy and power to an inertial fusion target are surveyed. The existing broad technology base of particle accelerators provides an important foundation for designing, costing, and evaluating proposed systems. The sequence of steps needed for the verification of the heavy ion approach is described; recent research results are even more encouraging than had been assumed hitherto.

49204 **A prospective light ion ICF driver.** Buttram, M.; Johnson, D.J.; Quintenz, J.P. (Sandia National Laboratories, Albuquerque, NM). pp 956-959 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Successful demonstration of inertial-confinement fusion in the laboratory could lead to economic operation of small (200 MWe) to large (2 GWe) power plants but extensive engineering developments in all aspects of the reactor will be required to achieve this goal. Two major elements of this development are the extension of the appropriate driver technology into the high average power regime and the development of suitable ion sources. At the present time the major efforts in all ICF research programs are devoted to achieving the beam power densities required to demonstrate nuclear fusion in the laboratory on a single pulse basis. (Several megajoules of energy must be deposited on a pellet a few millimeters in diameter in 10 ns or less to achieve nuclear burn.) Extending the driver and diode technologies to operate in the 1-10 Hz regime that will be required for reactors will be a major undertaking.

49205 **Strategies of design, development and activation of the Nova control system.** Holloway, F.W. (Lawrence Livermore National Laboratory, Livermore, CA). pp 486-491 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Nova and Novette are large complex experimental laser facilities which require extensive and sophisticated control systems for their successful operation. Often, in major controls projects, certain invisible aspects of the project, such as overall strategy, management, resource and historical constraints, have a more profound effect upon success than any specific hardware/software design. The design and performance of the Nova/Novette laser control system will be presented with special emphasis upon these often controversial aspects.

49206 **The assurance management program for the Nova laser fusion project.** Levy, A.J. (University of California, Lawrence Livermore National Laboratory, Livermore, California). pp 517-521 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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In a well managed project, Quality Assurance is an integral part of the management activities performed on a daily basis. Management assures successful performance within budget and on schedule by using all the good business, scientific, engineering, quality assurance, and safety practices available. Quality assurance and safety practices employed on Nova are put in perspective by integrating them into the overall function of good project management. The Inertial Confinement Fusion (ICF) approach is explained in general terms. The laser ICF and magnetic fusion facilities are significantly different in that the laser system is used solely as a highly reliable energy source for performing plasma physics experiments related to fusion target development; by contrast, magnetic fusion facilities are themselves the experiments. The Nova project consists of a 10-beam, 74 cm aperture neodymium-glass laser experimental facility which is being constructed by the Lawrence Livermore National Laboratory (LLNL) for the U.S. Department of Energy. Nova has a total estimated cost of $176M and will become operational in the Fall of 1984. The Nova laser will be used as the high energy driver for studying the regime of ignition for ICF. The Nova assurance management program was developed using the quality assurance (QA) approach first implemented at LLNL in early 1978. The LLNL QA program is described as an introduction to the Nova assurance management program. The Nova system is described pictorially through the Nova configuration, subsystems and major components, interjecting the QA techniques which are being pragmatically used to assure the successful completion of the project.

49207 **The S-1 Spheromak Control System.** Mathe, P.; Mika, R.; Oliaro, G. (Plasma Physics Lab., Princeton Univ., Princeton, NJ). pp 1984-1988 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The use of a CAMAC based DEC LSI-11/23 microcomputer to perform all control functions for the S-1 Spheromak is described. The system monitors and controls the three coil systems, Toroidal, Poloidal, and Equilibrium field coils and their associated power sources, the water cooling system, the personnel and machine safety system, the machine and diagnostic timing system and the control room display and operator interface. Future requirements include control of the vacuum system, the gas injection system and interface to the PPPL Data Acquisition System DEC10. The computer is connected to five remotely located CAMAC crates by a fiber-optic serial highway operating at five megahertz. These crates contain interface modules required to control the S-1 experiment. These modules include: D/A and A/D converters, fast transient digitizers, timing modules, temperature sensing modules, CRT alphanumeric display drivers, watchdog timers, and relay and TTL parallel I/O ports. The computer itself resides in crate #0 and consists of an LSI-11/23 with hardware floating post processor, memory management, 256K bytes of memory, four RS-232 serial ports and a 30 megabyte hard disk with a one megabyte floppy disk backup. The majority of software is written in FORTRAN with a few speed critical programs written in PDP-11 MACRO assembly language. The software simulates a sequential state machine which allows easily changeable logic since all logic is represented by standard Boolean Fortran statements. The RSX-11/m operating system allows multiple tasks to be active simultaneously. This provides computing time for operator interactions, editing of critical machine parameters, data analysis and transmission of data to other computers while still maintaining the scan activity which constantly monitors machine parameters.

49208 **Tokamak fusion test reactor facility clock system.** Montague, J. (Plasma Physics Lab., Princeton, NJ). pp 1965-1969 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The TFTR real time clock system provides the timing and synchronization of events for the total TFTR facility. Event times such as Start of Count, Start of Pulse and Start of Discharge are encoded on a Bi-Phase-Level serial clock signal which is distributed throughout the facility. Hardware in the CAMAC crates can detect the event times encoded on this clock signal and after a preset delay, generate a trigger pulse as required. The hardware used in this system is primarily standard CAMAC hardware. Three special modules were designed to handle the unique requirements of this system.

49209 **Mechanical design highlights of TFTR X-ray diagnostics.** Moshey, E.A. (Princeton Univ., Plasma Physics Laboratory, Princeton, NJ). pp 1559 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Previous TFTR x-ray diagnostic papers have described the overall mechanical design concept for an X-ray Imaging System (XIS) and a Pulse-Height Analysis System (PHA) for TFTR. This paper covers specific details of both diagnostic instruments. Both systems have been fabricated and are presently operating on TFTR.

49210 **Field installed brazed thermocouple feedthroughs for high vacuum experiments.** Anderson, P.; Messick, C. (GA Technologies Inc., San Diego, CA). pp 1555-1558 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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In order to reduce the occurrence of vacuum leaks and to increase the availability of the DIII vacuum vessel for experimental operation, effort was applied to developing a vacuum-tight brazed feedthrough system for sheathed thermocouples, stainless steel sheathed conductor cables and tubes for cooling fluids. This brazed technique is a replacement for elastomer "O" ring sealed feedthroughs that have proven vulnerable to leaks caused by thermal cycling, etc. To date, about 200 feedthroughs have been used. Up to 91 were grouped on a single conflat flange mounted in a bulkhead connector configuration which facilitates installation and removal. Investigation was required to select a suitable braze alloy, flux and installation procedure. Braze alloy selection was challenging since the alloy was required to have: 1) Melting temperature in excess of the 250°C (482°F) bakeout temperature. 2) No high vapor pressure elements. 3) Good wetting properties when used in air with acceptable flux. 4) Good wettability to 300 series stainless steel and inconel.

49211 **DT burning tokamak with low-activation materials Reacting Plasma Project.** Hamadu, Y.; Abe, Y.; Amano, T.; Fujita, J.; Kaneko, O.; Kawahta, K.; Kitayawa, S.; Kuroda, T.; Matsuoka, K.; Matsuura, K. (Inst. of Plasma Physics, Nayoya Univ.). pp 1550-1554 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A low-activation design of D-T Reacting Tokamak (R-TOKAMAK) in IPP Nagoya is presented. The vacuum vessel is made of aluminum alloy to reduce the induced radioactivity, and TF coils with copper conductors and aluminum alloy cases are covered with lead shield for the reduction of the gamma-ray dose. The conductors of poloidal field coils are also made of aluminum alloys, except the coils inside the throat of TF coils. Low-activation thick graphite tiles are designed to be fixed directly on the inner surface to protect the aluminum alloy vessel. In this design, the radiation level is significantly reduced to the level about 10^{-3} times that of a TFTR type design, and 10^{-4} times that of JET, in two weeks after D-T operation. This low activation device makes it possible to perform thousands of D-T shots without sophisticated remote handling scenario, and to study reacting plasma physics in detail, by the help of the advanced alpha-particle diagnostics.

49212 **Architecture of the control and data acquisition system of the JET experiment.** Bombi, F. (JET Joint Undertaking, Abingdon, Oxfordshire). pp 1362-1365 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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In June 1983 JET operation started successfully after a brief and intense commissioning period which completed the Construction Phase of the machine. The very first plasma discharges were obtained with the majority of the systems centrally controlled from the main control room and both engineering and diagnostic data were automatically collected by the multilevel data acquisition system, archived locally and in the off-site mainframe computing facility. This paper gives a brief description of the structure of the JET Control and Data Acquisition System with main emphasis on its hardware configuration leaving a detailed discussion of the underlying software to a different place.

49213 **Present status of the Doublet III control, acquisition, and archiving computer system.** Drobnis, D.D.; Kemper, C.; Shephard, G.W. (GA Technologies Inc., San Diego, CA). pp 1366-1369 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The computers at the Doublet III tokamak facility form a unified system for the control of device and beam operations, and presently acquire about four million bytes of data per shot. The information is formed into a unified database of machine conditions and diagnostic measurements, and transmitted over a 230 kbaud link to the GA User Service Center (USC) node on the Magnetic Fusion Energy (MFE) Network. There it is available within a few minutes after a shot for further analysis, either locally or elsewhere on the network. The system has evolved from a pair of disconnected minicomputers into a loosely coupled network of about twenty processors, ranging in power from LSI-11 microprocessors through minicomputers to a DECSystem-10 with dual KL-10 processors. The loose coupling serves to preserve the integrity and realtime performance of the online microcomputers and minicomputers, while providing a unified data structure for users from micro through mainframe. This allows FORTRAN programs to see a common data access method throughout. Considerable upgrades have been made to the system since its inception. In support of the Doublet III Vessel Modification Project (Big Dee), considerable additional enhancements are planned throughout the system of support computers, including those in the User Service Center.

49214 **EMI free fiber optic strain sensor system for TFTR.** Szuchy, N.C.; Caserta, A.L.; Ferrara, A.A.; Squires, R.W.; Sredniawski, J.J. (Grumman Aerospace Corp., Bethpage, NY). pp 1370-1374 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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In certain applications, structural components are subjected to loadings in high electromagnetic interference (EMI) environments. The mechanical responses of these components must be monitored under rapidly varying electromagnetic fields. A Fiber Optic Strain Sensor System (FOSSS) is an acceptable solution since it is immune to EMI. Grumman Aerospace Corporation initiated the development of a FOSSS that can be used in high EMI situations where resistive/electronic-based strain measurement systems would not be effective, such as on the Tokamak Fusion Test Reactor (TFTR) during plasma disruption. Tests have indicated that because of their increased sensitivity due to the size of the fiber optic (FO) transducer (1-in.^{2}) and responsiveness due to the areal changes of the FO sensor, the strain tracking capability of FO sensors are excellent. For the TFTR application a jacketed 400-micron fiber capable of operating in a 250°C temperature environment was used. Continuous 30 foot lengths of high-temperature FO cables were affixed to 304 LN SS tabs, forming an integrated strain sensor and pigtail unit. By fusion splicing 400-micron room temperature fibers to the pigtails, the required runs (approximately 200 feet) to the TFTR data acquisition room were made with minimum coupling attenuation. Development methodology is discussed and test data presented.

49215 A noise filtering algorithm for the MFTF-B computer based control system. Minor, E.G. (Lawrence Livermore National Laboratory, Livermore, CA). pp 1375-1379 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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An algorithm to reduce the message traffic in the MFTF-B computer based control system is described. The algorithm filters analog inputs to the control system. Its purpose is to distinguish between changes in the inputs due to noise and changes due to significant variations in the quantity being monitored. Noise is rejected while significant changes are reported to the control system data base, thus keeping the data base updated with a minimum number of messages. The algorithm is memory efficient, requiring only four bytes of storage per analog channel, and computationally simple, requiring only subtraction and comparison. Quantitative analysis of the algorithm is presented for the case of additive Gaussian noise. It is shown that the algorithm is stable and tends toward the mean value of the monitored variable over a wide variety of additive noise distributions.

49216 System design for JT-60 failure mode analysis and prediction. Kurihara, K.; Anno, K.; Hosogane, N.; Kimuru, T.; Kondo, I.; Takakushi, M.; Yonekawa, I.; Yoshino, R. (Japan Atomic Energy Research Inst.). pp 1954-1958 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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JT-60 as a large-scale plant is designed to have the safety hard-wired interlock system for failure. In addition, plant support computer always monitors the state of JT-60 device or abnormal events. In the subsystems a part of those alarms are directly transmitted to interlock system as well. Therefore, if the table which indicates the fault flow of the plant is prepared in the computer beforehand, the computer can propose the alarms which have the possibility to hit the interlock and can display the trip sequence and the change of plant condition before and after the failure. Moreover, once the operator decides the first alarm among those proposed by the computer, he can ask to the computer what to check and what to repair. (Analysis) Only during discharge JT-60 is brought up to the high excitation stage, which may cause the fatal failure. The primary cause varies according to the discharge condition and/or the plant state, but it is possible to predict the failure by means of analysing various information. The computer, for example, examines whether the coils' stress increases over the limit or not, when the coils are excited with preprogrammed current patterns. Vacuum vessel temperature, coil temperature, possibility of run-away discharge or abnormal discharge, etc. are also planned to be checked, and part of the algorithm is now under consideration. This function is mainly performed as of the pre-shot check items just before the discharge and without any undesirable prediction the sequence can go forth.

49217 Status of the Tandem Mirror Experiment-Upgrade (TMX-U) diagnostic system. Coutts, G.W.; Coffield, F.E.; Hornady, R.S. (Lawrence Livermore National Laboratory, Livermore, CA). pp 1948-1953 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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This paper presents the current status of the Tandem Mirror Experiment-Upgrade (TMX-U) diagnostics system. For the initial instruments active on TMX-U, the expansions or upgrades that have been implemented are outlined. For the newly added systems, more implementation details are presented.

49218 Software design for the EBT-P data acquisition and control system R & D. Boyd, R.A. (McDonnell Douglas Astronautics Co., St. Louis, MO). pp 1947 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The instrumentation and control system for the EBT-P device is composed of a hierarchy of programmable logic controllers, microprocessor-based data acquisition computers, and a large minicomputer-based facility computer system. The software being developed to support this data acquisition and control system is necessarily quite complex due to several requirements imposed upon the EBT-P overall design criteria. These requirements, which include such considerations as overall reliability, operator interface, real-time display, interprocessor communication, and minimum cost to build, operate, and maintain, dictate that the software be developed in a well structured and controlled manner. To this end, structured software engineering practices are being applied to the design and development of the EBT-P data acquistion and control software. The design process began with the production of a software Requirements Document which describes the hardware and software environment in which the software development takes place. It identifies the major deliverable software items to be produced and describes the practices to be used to design and develop the software. The software design is split into three components: the facility computer software, the microcomputer software, and the PLC software. Within these physical boundaries, the following five functions are defined: data acquisition, display, communication, storage, and control. The software design is further detailed in a Structured Specification Document for each of the three physical components. Each specification describes the software in detailed terms so that a programmer can directly write the required software. Each specification is composed of: data flow diagrams, a data dictionary, structure diagrams, and program design language mini-specifications. Examples of the design issues exposed and addressed during the structured decomposition of EBT-P software processes are discussed in detail.

49219 Remote erosion measurements in controlled fusion experiments and reactors. Halverson, W.; Sioshansi, P. (Spire Corp., Bedford, MA). pp 1937-1941 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Techniques for remote measurement of the erosion of critical components will soon be required in large, complex fusion experiments and ultimately in reactors. The Surface Layer Activation (SLA) method utilizes small quantities of radionuclides induced directly in the eroding surface and the erosion measured by following the decrease of characteristic gamma-ray intensity from the activated region. A proof-of-principle demonstration is suggested which would precede the design of a remote erosion monitoring system for tokamak limiters or other fusion components.

49220 Reliability aspects in the JT-60 central control system design. Kondo, I.; Hosogane, N.; Kimura, T.; Kojima, T.; Kurihara, K.; Matsuki, T.; Nakayama, T.; Takemaru, K.; Yonekawa, I.; Yoshino, R. (Japan Atomic Energy Research Inst., Tokyo). pp 1933-1936 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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This paper gives a detailed description of the several check functions of the JT-60 central control system during the plasma experiment. The main features of these check functions are: (1) Optimum check and confirmation of parameters and device states according to the plasma experiment flow, (2) Preventation from the operator's miss setting, (3) Continuous monitoring and confirming of the states of machines and equipments.

49221 Retrieval and handling of online acquired data from the Tokamak Experiment Textor. Korten, M. (Institut fuer Plasmaphysik, Kernforschungsanlage Juelich GmbH). pp 1928-1932 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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At the TEXTOR tokamak experiment at Juelich, a computerized data acquisition system is used for collection, storage and analysis of the experimental data, presently about 1 Mbyte of data per discharge. The local TEXTOR computer and storage facilities - a VAX11/780 system and two 300 Mbyte disk drives - provide for a centralized storage and software interface for a standardized shared access to the experimental database. While the man-machine interface and optimized data throughput is important for the control and data acquisition phase, the form of data storage is of major relevance for the availability and flexible handling of the resulting large data quantities. During the data acquisition phase of TEXTOR, all diagnostic systems operate in a decentralized and independent mode, synchronized only by the timing system. As a result, each subsystem creates its own data storage file. This reflects the independent control and acquisition processes during the TEXTOR operation. A set of global diagnostic channel descriptors are saved along with the data and serve as keys for the subsequent data processing phases. For retrieval, then, the organization into a set of experimental units is suitable for the technical documentation while for the diagnostic data analysis the data can be seen as a set of standardized channels. They represent the various physical quantities without regard to the different experimental data acquisition techniques. The data channel is described by a unique system wide name to be used to open a data path to the requested data, which, together with a set of standard retrieval routines, simplifies the application software generation for intershot analysis and more refined calculations after a sequence of shots.

49222 Scheduling and control of programs in the CICADA computer system for TFTR. Christianson, G.B.; Sherrick, M.; Stark, W. (Princeton Univ., Plasma Physics Laboratory, Princeton, NJ). pp 1946 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The CICADA computer system is a network of super minicomputers for data acquisition, reduction, display and device control on the TFTR experiment. Human interaction with the CICADA system is accomplished by consoles offering color displays with a high degree of operator interaction with the computer system, and by interactive terminals offering a limited degree of operator interaction. The authors describe the software packages and data bases used to control the consoles and provide communication to an application program attached to a console. The console control program in its turn schedules the execution of control programs that furnish operating system interfaces to applications programs executing at a console or terminal (in response to human activation), or upon activation by scheduling tasks. The control programs handle functions such as applications task activation. They discuss the implementation of the control programs in the multicomputer CICADA environment, and describe the control program data bases. In a TFTR shot cycle, applications programs must be scheduled for activation at operator-defined stages, in order to accomplish the arming of hardware devices, acquisition of summary waveform data, and the acquisition and archiving of raw data. The authors describe the software tasks and data bases of the CICADA event system, which accomplishes this scheduling of applications task activation in conjunction with the control programs. Future enhancements planned for the console control, program control, and event systems are outlined.

49223 Inter-shot processor system for JT-60. Ohasa, K.; Kambe, T.; Mochizuki, O.; Toyokawa, R.; Yanai, Y. (Japan Atomi Energy Research Inst.). pp 1916-1918 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A data processing system for JT-60 was reported earlier. The data acquisition and processing system for JT-60 consist of 8 subsystems that have hierarchical structure. This paper describes design role of one subsystem named Inter-shot Processor (ISP) system. Role of the ISP system to collect diagnostic data from CAMAC crate, analyze them, display the results, print them on the laser printer, and feed them to the database. It completes those procedures during a shot interval. Because of following reasons, a general purpose computer FACOM M-360 Multi Processor are used. 1) Powerful processing ability for analysis. 2) Able to equip with large disk unit for various diagnostic data and results of analysis. 3) Abundant software facility for data processing and management.

49224 Improvement in MFTF data base system response times. Lang, N.C.; Nelson, B.C. (Lawrence Livermore National Laboratory, Livermore, CA). pp 1912-1914 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The Supervisory Control and Diagnostic System for the Mirror Fusion Test Facility (MFTF) has been designed as an event driven system. To this end the authors have designed a data base notification facility in which a task can request that it be loaded and started whenever an element in the data base is changed beyond some user defined range. The initial implementation of the notify facility exhibited marginal response times whenever a data base table with a large number of outstanding notifies was written into. In this paper they discuss the sources of the slow response and describe in detail a new structure for the list of notifies which minimizes search time resulting in significantly faster response.

49225 Thermal and structural analysis of a neutralizer plate for the TFTR pumping system. Dinkevich, S.; Shaaban, A. (EBASCO Services Inc., New York, NY). pp 1911 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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To increase the efficiency of the surface pumping panels installed in the TFTR Vacuum Vessel, it may be possible to add a perpendicular scraper blade (Neutralizer Plate) as a reflector. The blade would extend in the space above the surface pumping panels towards the plasma. The neutralizer plate, being close to the plasma will be subjected by particle's collection to very high heat flux of impulsive and repetitive nature. To define a probable configuration of the blade, thermal and structural analysis was conducted using the finite element method. The NASTRAN code was used for both applications. Three plasma scenarios were considered in this analysis. One of these scenarios resulted in a very steep heat flux gradient that rendered the analysis conspicuously unstable and a new finite element model needed to be developed. This finding is presented and explored in the paper so such an instability could be avoided in future heat transfer analysis by the finite element method. One of the interesting topics presented is a demonstration of how it is possible to shape neutralizer plates by eliminating hot spots that otherwise would adversely affect the plates. Another unexpected finding was the possibility to eliminate the expansion slats in the plate material. The findings reported in this paper will serve to guide future efforts in the analysis and design of neutralizer plates.

49226 Stability of the FMIT high speed, free surface liquid jet flowing along a curved back wall. Hassberger, J.A. (Westinghouse Hanford Co., Richland, WA). pp 1849-1853 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Measurements of surface wavelengths observed on the surface of curved wall, free surface liquid jets are presented. Tests were performed in both liquid lithium and water in a Reynold's number range from 200 to 400, based on the surface speed and boundary layer displacement thickness. Results are found to compare favorably with observations of free surface flows in both submerged cavities and cylindrical jets. An effect of surface tension is observed from these results.

49227 Mechanical design considerations for a precision, ultra high vacuum manipulator. Ellis, R. (Princeton Univ., Plasma Physics Laboratory, Princeton, NJ). pp 1798-1802 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The design of mechanisms for use in an ultra high vacuum (UHV) environment presents special problems. The additional design constraints due to requirements of fusion machines further limit the engineer's flexibility in the design process. Requirements for precise control of position and large range of motion present a further challenge. With the advent of tritium in fusion devices, reliability and ease of remote maintenance are matters of paramount importance. The design of the TFTR impurity injector illustrates some of these problems and their solutions. The effects of different impurities on a plasma can be studied by injecting small amounts of an impurity into the plasma and using other diagnostic instruments to record the results. A thin layer of an impurity is coated on a glass slide which is approximately two inches square. A high energy laser beam is focused onto a small spot on the slide. When the laser is pulsed, the impurity evaporates from the target and drifts into the plasma. The TFTR impurity injector will hold sixteen coated slides inside a vacuum. The required positioning accuracy is one tenth of a millimeter. Simultaneous requirements for a large range of motion and high positioning accuracy present unusual design problems. Requirements for radiation resistance and remote maintainability have an impact on the design. In this paper, the trade-offs between different design methodologies are discussed in detail. Various design concepts for the TFTR impurity injector are analyzed from the standpoints of functionality, reliability, and cost; the results are generalized so that they will be of use to other designers.

49228 Concepts and status of remote handling in JET. Dean, J.; Raimondi, T. (JET Joint Undertaking, Culham, Abingdon, Oxon). pp 1793-1797 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The design of JET is such that the main subassemblies are replaceable remotely by a combination of the crane, servomanipulators and special tools. Special features to facilitate remote handling are described in the JET Remote Handling Manual. Servomanipulators are floor mounted. Their tranporters only require the crane to carry and position them in their working areas, so that the mobility and availability of the crane are maximised. The installation of large subassemblies such as the octants and the PF coils have shown that the concepts adopted can be viable for Remote Handling. Recent development work has concentrated on equipment needed early in the operating programme. The in-vessel inspection system, using TV sets remotely controlled to inspect the vessel with 0.5 mm resolution, without breaking the vacuum, is being commissioned. The in-vessel articulated boom, able to reach 180° of the vessel from either of two opposite ports, to handle the limiter or support the manipulator, is being manufactured. The automatic cutting and welding equipment for the octant joints and the Neutral Injector joints has been used for initial installation.

49229 Maintenance and availability considerations for MFTF-B upgrade. Spaminato, P.T. (Oak Ridge National Laboratory, Oak Ridge, TN). pp 1788-1792 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The upgrade of the Mirror Fusion Test Facility (MFTF-B) tandem mirror device incorporates the operation of advanced systems plus the requirement for remote maintenance. To determine if the operating availability goal of this device is achievable, an assessment of component lifetimes was made, along with estimates of device downtime. Key subsystem components were considered from the magnet, heating, impurity control, pumping, and test module systems. Component replacements were grouped into three categories, and a lifetime operating plan, including component replacements, was developed. It was determined that this device could achieve a 10% operating availability.

49230 Engineering aspects of the Riggatron ignition device. Jacobsen, R. (Int. Nuclear Energy Systems Co. Inc., La Jolla, CA). pp 1808-1813 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The design of compact, high-field tokamak ignition devices, based on modern high-strength, high-conductivity copper alloys, is presented. The systems studies which guided the design are addressed as are the needs of the critical components, including the toroidal field coil, the ohmic field coil and the first wall/vacuum vessel. An integrated design meeting the needs of an ignition device is presented.

49231 Vacuum vessel and first wall thermocouple instrumentation on TFTR. Ferrara, A.A.; Sredniawski, J.J. (Grumman Aerospace Corp., Bethpage, NY). pp 2078 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The temperature instrumentation of TFTR is designed to monitor critical vacuum vessel surface temperatures resulting from pulsed operation, discharge cleaning, bakeout and the gobal thermal effects of first wall components, primarily during the period between pulses. The vacuum vessel instrumentation consists of 231 Type "E" thermocouples while the first wall instrumentation consists of 193 Type "E" thermocouples. Temperature responses are processed and are used to limit the operation of the machine to avoid over-stressing critical vacuum vessel structural areas and first wall components. This paper describes the complete thermocouple system including thermocouple assemblies, voltage isolation and temperature processing equipment as presently installed and operating in the TFTR complex.

49232 Eddy currents and forces on the RFX vacuum vessel after hard disruptions. Gnesotto, F.; Martone, R.; Rubinacci, G.; Sonato, P. (Istituto Gas Ionizzati del CNR-Associazione EURATOM-CNR-Padova). pp 1208-1212 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The paper describes, from the viewpoint of the electrical behaviour, the main characteristics of the RFX vacuum vessel. The calculation of eddy currents and electrodynamic loading produced during fast plasma current terminations is performed by means of an analytical method that solves the problem under specified simplifying assumptions. A numerical code has been implemented to test the accuracy of these computations: the results of the comparison are reported in the paper. The sensitivity of the loading to the initial plasma conditions and to the time evolution of the plasma current during the disruption phase is finally discussed.

49233 Tokamak Fusion Test Reactor - CICADA, an overview. Sauthoff, N.; Bosco, J.; Daniels, R. (Princeton University, Princeton Plasma Physics Laboratory, Princeton, NJ). pp 900-904 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The Central Instrumentation, Control and Data Acquisition (CICADA) System provides the interface between the human operators and the equipment to be controlled and monitored in support of TFTR operation. The functions can be partitioned into those that are instantaneous and fundamental components of a processed control system (such as displaying the current monitored value of a point or changing the state of a piece of equipment) and those that are more complex, being composite actions executed in sequences either related to the TFTR shot cycle or in the execution of timed procedures for the operation of subsystems. In this paper, the authors present the configuration of the equipment "from the outside in" - meaning from the man and equipment external interfaces inward toward the components internal to the CICADA system; they next present an overview of the fundamental operations, including the concept of the CICADA devices, the assignment of values to the elements of the definition of the device, the monitoring procedure for all of the devices on the system, the control process including the assignment of control authorization, the handling of special devices such as diagnostic data acquisition and timing modules, and graphics. Next they proceed to discuss composite actions and timed sequences which support the TFTR cycle; included are the system for activating, suspending, and resuming tasks in response to the occurrence of hardware and software events, and the typical sequence of tasks involved in operation of a subsystem for data acquisition during the shot cycle and the archival of raw and results data; special cases will be the real time control systems for the plasma position and current and the gas injection system, both of which provide closed-loop feedback control of plasma position, current and lineintegrated density throughout the shot. Finally, future directions and initiatives discussed.

49234 **End cell I & C requirements for operating Tandem Mirror Reactors.** Gorker, G.E.; Osher, J.E. (Fusion Engineering Design Center, Oak Ridge National Laboratory, Oak Ridge, Tennessee). pp 910-914 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The next generation of fusion reactors will be developed to achieve near-ignition conditions and operate in a tritium environment for significant periods of time. Radiation-hardened diagnostic instrumentation must be developed for these reactors. Although neutral beam injection (NBI) will be used for plasma heating and fueling of experimental fusion machines like MFTF-α+T, it is believed that ion cyclotron resonance heating (ICRH) will be used in future machines for heating the plasma. When RF heating is used, fueling will be accomplished with gas puffing and advanced fuel injectors. End cell coils, NBI, and microwave power injectors are needed to provide adequate confinement. Microwave power and NBI control the electrostatic potentials of the plug and barrier. Low-frequency RF power provides drift pump control of the ions so that they are lost radially, enhancing the use of direct converters that collect the axially flowing electrons. Direct or indirect measurements of electrostatic potential barriers, electron density, and temperature appear necessary to control the NBI and microwave power generators. This paper discusses some of the end cell instrumentation and control (I & C) systems believed to be necessary for tandem mirror reactors.

49235 **Fiber optic telemetry techniques in fusion environments.** Head, J. (Optical Data Systems, Richardson, TX). pp 915-919 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The use of fiber optic communication links in fusion research is widespread. The applications range from the control and monitoring of simple switches to integrated communications systems which integrate machine control, data acquisition, and video monitoring onto a common network.

49236 **TFTR CAMAC instrumentation system.** Del Gatto, H.J.; Bradish, C.J. (Princeton Plasma Physics Laboratory). pp 920-924 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The TFTR Central Instrumentation Control and Data Acquisition (CICADA) system makes extensive use of CAMAC equipment. The system consists of eight CAMAC highways operating from eight Gould 75/32 computers. Links up to 3.5 miles in length with more than fifty CAMAC crates have been implemented and are currently in use. Data transfer along the highway is implemented in bit serial format. The link speed is run at 5MHz. The length and complexity of the link requires the reformatting of the NRZ input/output format of the L-2 crate controller. U-Port adapter modules are used to interface the modified serial highway to the L-2 controllers. The modified serial highway uses a transmission technique that requires the distribution of both Bi-Phase encoded data and a 5MHz clock. The Serial Driver interfaces to the GOULD computer through use of a High Speed Data (HSD) interface board which attaches to the computers internal bus. All transfers to and from the computer are accomplished by direct memory access (DMA). In addition to the standard CAMAC link the system also includes a Block Transfer (BT) system. This system provides an alternate path for transferring data between the computers and the CAMAC modules. The BT system is interfaced to the host computers through HSD boards and to the CAMAC crates through use of an auxiliary crate controllers.

49237 **Offline processing of Doublet III data.** Drobnis, D.; DeBoo, J.; Dy, B.; Ejima, S.; Stockdale, R. (GA Technologies Inc., San Diego, CA). pp 928-931 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Computing requirements for physics data from the Doublet III tokamak are particularly heavy because of Doublet III's design goal of investigating the effects of shape upon plasma confinement and other parameters. The resulting large variety of unsymmetrical plasma shapes complicates analysis and modeling. This problem was anticipated at the time of the initial design of the data acquisition system for Doublet III and caused considerable emphasis to be placed upon use of the MFE Network and User Service Center for post-shot analysis. This has proved to be a wise decision, for the amount of offline computing now done on physics data offline exceeds that done online by well over an order of magnitude. Each Doublet III shot presently produces about 4 million bytes of raw data, and processing between shots is limited to a maximum of 5 CPU minutes on ModComp 7870 computer.

49238 **Present status of fusion research and development at Japan Atomic Energy Research Institute.** Kimura, T.; Iso, Y. (Japan Atomic Energy Research Inst.). pp 34-38 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Japan Atomic Energy Research Institute (JAERI) is one of the major research institutes in Japan, and at JAERI, JT-60 Development Program, Tokamak Experiment Program and Fusion Reactor Technology Development Program are in progress as the center of the fusion research and development. Its major activities cover the following fields.

49239 **Status and prospectives of the JET project.** Bertolini, E.; Huguet, M. (JET Joint Undertaking, Abingdon, Oxon). pp 39-45 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The Joint European Torus (JET), whose design started towards the end of 1973, has been constructed and will be operated by the JET Joint Undertaking, which was established for 12 years, by the Council of Ministers of the European Communities in 1978. The plan was to build the machine in 5 years and then start operation, progressively bringing the plasma to conditions close to those required in a thermonuclear fusion reactor. The first goal has been achieved on time and after a short period of operation, plasma currents up to 2 MA have been obtained. The future plans of the Project, for which full approval has been obtained, are described in some detail and include, as ultimate goal, thermonuclear experiments.

49240 **Using PAFEC as a preprocessor for MSC/NASTRAN.** Gray, W.H.; Baudry, T.V. (Oak Ridge National Laboratory, Oak Ridge, TN). pp 60-64 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Programs for Automatic Finite Element Calculations (PAFEC) is a general-purpose, three-dimensional, linear and nonlinear finite element program. PAFEC's features include free-format input using engineering keywords, powerful mesh-generating facilities, sophisticated database management procedures, and extensive data validation checks. Presented here is a description of a software interface that permits PAFEC to be used as a preprocessor for MSC/NASTRAN. This user-friendly software, called PAFMSC, frees the stress analyst from the laborious and error-prone procedure of creating and debugging a rigid-format MSC/NASTRAN bulk data deck. By interactively creating and debugging a finite element model with PAFEC, thus taking full advantage of the free-format, engineering-keyword-oriented data structure of PAFEC, the stress analyst can drastically reduce the amount of time spent during model generation. The PAFMSC software will automatically convert a PAFEC data structure into an MSC/NASTRAN bulk data deck. The capabilities and limitations of the PAFMSC software are fully discussed.

49241 **The impact of measurement assurance with MIL STD 45662.** Ekvall, D.N. (Leeds and Northrup Co., North Wales, PA). pp 76-77 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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All quality technologies have gone through a maturity process that started with activity oriented requirements and progressed to recognition of purposeful objectives. The development of measurement assurance technology has been no different. It has always been accepted that calibration of measurement devices was good but with each industry and regulatory agency requirement in this field the objectives have been more specifically pronounced. The change from MIL C 45062A "Calibration System Requirements" to MIL STD 45662 is typical of such maturity. The changes have been subtle but they are significant. This paper discusses the changes that have occurred, their nature and rationale. The most significant impact of these changes will involve operational and economic consequences that will require reaction from those with measurement assurance responsibilities. Traceability will extend in both directions, back through the standard's chain and forward through the product and process flow data visibility and retrieval actions, as well as pre-planned responses to measurement discrepancy will pose now problems for the quality professional.

49242 **Low activation vacuum vessel for R-Tokamak.** Ogawa, Y.; Hamada, Y.; Itoh, S.; Kitagawa, S.; Matsuoka, K.; Matsuura, K.; Swada, Y.; Tui, K.; Yamada, M.; Yamazaki, K. (Inst. of Plasma Physics, Nagoya Univ., Nagoya). pp 84-88 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The vacuum vessel design of R-Tokamak, which is a moderate-size DT experimental device, is presented. To reduce the induced radioactivity due to DT neutrons, the vacuum vessel is made of aluminum alloy. Polyimide insulation is adopted to obtain high toroidal one-turn resistance, and double vacuum seal is applied using both polyimide and EP rubber O-rings to prevent tritium leakage. Electromagnetic forces, which act on the vacuum vessel, are due to (a) magnetization of the toroidal field at each discharge, (b) trip of the TF power supply and (c) plasma current disruption. In the cases (a) and (b) forces for the Al-alloy vacuum vessel become very large compared with those for AISI 304 SS, because the characteristic time in the magnetic field change is longer than the skin time of the vacuum vessel. In order to sustain the load of the case (a), which acts on the vacuum vessel as a hoop force, lots of insulated bolts are installed. In order to support the electromagnetic force due to plasma current disruption, flanges at the break section are fastened with insulated pins and insulated reamer bolts. The static, buckling and thermal stress analyses have been made with FEM code. The result of the static analysis shows that maximum stress intensities are lower than the allowable values for Al-alloys. It is found that the critical buckling mode is the deformation of the inner straight section of the torus with n=4 mode. The thermal stress is relatively low, because the maximum temperature is limited below about 120°C and the heat conductivity of Al-alloy is high.

49243 **TFM/TFTR Vacuum vessel stress analysis.** Rogoff, P. (Princeton University, Plasma Physics Laboratory, Princeton, NJ). pp 93-97 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Several Finite Element Models (FEM) were created to simulate the TFM/TFTR Vacuum Vessel (VV) structure and to study its behavior during static and dynamic environments. Model #5 is one such model and represents the VV structure which consists of: the shell, stiffening rings, all the support structure, approximate mass distribution, and proper boundary fixities. This model is the final one in the series of models which were used to study: a) The free toroidal shell, Model #1 b) The free toroidal shell and stiffening rings, Model #2. c) Toroidal shell with stiffening rings and inboard and outboard support structure, Model #3 d) Toroidal shell with stiffening rings, inboard, and outboard support structure, and total mass simulation, Models #4 and #5.

49244 **Static and dynamic analyses on the MFTF-B vacuum vessel.** Ng, D.S. (Lawrence Livermore National Laboratory, Univ. of California, Livermore, CA). pp 98-104 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The Mirror Fusion Test Facility (MFTF) is one of the magnetic fusion energy projects at the Lawrence Livermore National Laboratory. One of the major components of this fusion test facility is the vacuum vessel which forms the vacuum chamber. The vessel is supported on twenty-two pairs of legs resting on reinforced concrete piers. This paper is a report of the static and dynamic analyses on the vacuum vessel. In this analyses the authors investigated the load distribution under the gravity loads, the pressure loads, the electro-magnetic loads and the thermal loads separately. They also performed a series of sophisticated dynamic analyses to predict the structure behavior under the postulated earthquake. The modeling assumptions and analysis procedures are highlighted in this paper.

49245 **DATA management for TFTR.** Christianson, G.B.; Chu; Randerson, L.R. (Princeton Univ. Plasma Physics Lab., Princeton, NJ). pp 273 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The TFTR experiment generates such a large amount of data each shot that only a restricted subset of the acquired data is displayed quickly, so that operational physicists can control and direct the experiments. The authors discuss the software tasks and data structures used to acquire this summary data and present it in a graphical form. After the summary data has been acquired and displayed, the large quantity of diagnostic physics and engineering data must be acquired and placed on bulk storage devices. They describe the software tasks and data bases used to accomplish this, and indicate future enhancements. Experimental systems often require peripheral data files and data bases. They describe the means by which auxiliary files are associated with primary acquired data for a shot, and discuss ancillary data bases. The authors outline future plans for auxiliary data base management to aid in the offline analysis of past data. Summary, raw and processed data must be reliably archived to a permanent storage medium. The archival procedure and management of the archival directory to permit orderly retrieval of data for offline analysis are described. Finally, archived data must be formatted in a standardized fashion to permit access by a broad community of users. At the same time, the large amounts of data to be archived make an efficient format necessary. The formatting of data files and outline future plans for transmittal of archived data to other computer systems are described.

49246 **Data processing system for real-time control.** Oasa, K.; Mochizuki, O.; Toyokawa, R.; Yahiro, K. (Japan Atomic Energy Research Inst.). pp 274-278 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Real-time control, for large Tokamak JT-60, requires various data processings between diagnostic devices to control system. These processings require to high speed performance so that it aims at giving information necessary for feedback control during discharges. Then, the architecture of this system has hierachical structure of processors. These processors are connected each other by the CAMAC modules and the optical communication network, which is the 5 M bytes/second CAMAC serial highway. This system has two kinds of intelligences for this purpose. One is ACM-PU pairs in some torus hall crates which has a microcomputerized auxiliary controller and a preprocessing unit. Other is real-time processor which has a minicomputer and preprocessing unit. Most of the real-time processing, for example Abel inversion are characteristic to the diagnostic devices. Such a processing is carried out by an ACM-PU pair in the crate dedicated to the diagnostic device. Some processings, however, are also necessary which compute secondary parameters as functions of primary parameters. A typical example is Zeff, which is a function of Te, Ne and bremsstrahluny intensity. The real-time processor is equipped for such secondary processings and transfer the results. Preprocessing unit - PU- attached to ACM and real-time processor contains a signal processor, which executes in parallel such function as move, add and multiply during one micro-instruction cycle of 200 nsec. According to the progress of the experiment, more high speed processing are required, so the authors developed the PU-X module that contains multi signal processors. After a shot, inter-shot-processor which consists of general-purpose computers, gathers data into the database, then analyze them, and improve these processes to more effective.

49247 **Analysis of the Umbrella Roof for lifting.** Shaaban, A. (EBASCO Services Inc., New York, NY). pp 2008 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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In addition to supporting the dead loads and the operational loads, the Umbrella Roof (UR) has two major functions to which it was designed. First is to allow access for repair and removal of any of the TF coils, the upper PF coils and the Vacuum Vessel sections; and second, is to reproduce the exact positioning of the upper PF coils every time the UR is placed over the Tokamac. To provide these functions, the UR is designed to be lifted as one integrated structure to which the upper PF coils are attached. In order to ensure precise positioning of the UR, a redundant system of 13 guide pins were provided on the bottom of the radial beams, and four shear lugs were provided atop the central column. Mating reciprocals with very close tolerance for the guide pins were provided in the tops of the 13 peripheral columns. To meet close tolerances and to accommodate such high redundancy in match points, accurate analysis was necessary by which the center of gravity of the UR can be located and the deflection of all match points can be computed. Also stress analysis of the members of the UR was necessary because when the UR is lifted it is denied the midpoint support over the center column; and also the beams of the UR are not interconnected by moment-capable joints, thus if provisions are not made to support every radial beam, those which are not supported would yield and collapse. In this paper, the lifting schemes proposed for the UR are discussed and the results of the analysis performed for the elected scheme are presented. Also presented is a unique application of the NASTRAN code by which the center of gravity of the UR was located by allowing a refined model of the UR to swing until it came to rest under an arbitrary lift point.

49248 **Macro and Micro seismic analysis of TFTR structure.** Shaaban, A. (Ebasco Services, New York, NY). pp 2009 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Because of the special configuration and operational loading of the tokamaks, their supporting structures assume common architectural shapes and structural systems. These shapes and systems prove to be susceptible to seismic motions causing the tokamac supporting structure to respond vigorously. Studies done by the writer indicate that the Umbrella Roof type of structures tend to possess natural frequencies that match the dominant frequencies of the typical seismic motions, giving rise to quasi-resonant conditions. Indeed, for the case of the TFTR, seismic loads became a factor in the design of the upper PF coils supports, the Umbrella Roof and the center and the peripheral columns. This is in spite of the fact that the Princeton site is considered a seismically weak one with a ZPA of 0.065 g for the most probable earthquake. If the tokamak type of reactors will be built on larger scales and/or on sites that could have moderate to strong seismic motions, there is little doubt that the seismic forces will be a major concern, probably governing the design of some key components and many connections. This paper addresses such possibilities in light of the analysis performed for the TFTR. This paper addresses two types of seismic analysis, Macro and Micro. By Macro is meant the global analysis of the structure incorporated with the surrounding buildings and soil. This type of analysis serves to produce response spectra curves and other important data that are used by various disciplines to seismically design their components. Micro analysis on the other hand deals with the members and components of the individual structures by which deformations, bending moments and stresses can be evaluated. The results reported herein are expected to serve the designs of the supporting structures of tokamaks to come.

49249 **The TARA control, data acquisition and analysis system.** Gaudreau, M.P.J.; Fredian, T.W.; Karcher, C.A.; Sevillano, E.; Stillerman, J.; Sullivan, J.D.; Thomas, P. (Plasma Fusion Center, Massachusetts Institute of Technology, Cambridge, Massachusetts). pp 2010-2014 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The MIT tandem mirror (TARA) control, data acquisition and analysis system consists of two major parts: 1) a Gould 584 industrial programmable controller (PC) to control engineering functions; and 2) a VAX 11/750 based data acquisition and analysis system for physics analysis. The PC is designed for use in harsh industrial environments and has proven to be a reliable and cost-effective means for automated control. The PC configuration is dedicated to control tasks on the TARA magnet, vacuum, RF, neutral beam, diagnostics, and utility systems. The data transfer functions are used to download system operating parameters from menu selectable tables. Real time status reports are provided to video terminals and as blocks of data to the host computer for storage. The data acquisition and analysis system for TARA was designed to provide high throughput and ready access to data from earlier runs. The adopted design uses pre-existing software packages in a system which is simple, coherent, fast, and which requires a minimum of new software development. The computer configuration is a VAX 11/750 running VMS with 124 M byte massbus disk and 1.4 G byte unibus disk subsystem. The front end for the data system is a Kinetic Systems CAMAC serial highway interface, and the graphics I/O is done through a DMA terminal multiplexer. The data system provides a set of standard tools for use in user-written analysis programs. These tools allow access to current shot data as well as to past shots with a minimum of overhead. The acquisition, archival, basic analysis, and display of 1 M byte of data for every shot is accomplished once every 3-5 minutes, and any shot may be easily reanalyzed.

49250 **Cryogenic retention system for the de-activation of nitrogen.** Pinter, G.R. (Grumman Aerospace Co., Bethpage, NY). pp 1255-1256 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Fusion machines use liquid nitrogen cooled radiation shields to reduce heat input into cryogenic helium cooled pumping panels. Neutrons will activate normal nitrogen via the n→2n reaction, producing N^{13} with a half life of about 9.9 minutes. Upon emitting an energetic (about 0.5 MeV) γ, the activated nitrogen will fall back into a stable carbon isotope. This γ emission makes special handling of the activated nitrogen necessary. Storage of the activated nitrogen in gaseous form has been considered but rejected because of the large shielded volume required. Use of a closed nitrogen loop for heat removal is a viable alternative but has undesirable features since the activity level of the recirculated nitrogen, and thus the time before such installation may be entered and serviced, will depend on the frequency of plasma shots. This is a definite drawback in the light of the need for at least one moving part - a liquid nitrogen pump requiring servicing at about 2000-hour intervals. A cryogenic re-liquefaction scheme is presented here to overcome these difficulties. It does not employ rotating machinery in the activated fluid area and can retain the fluid for the desired length of time. This is accomplished by passing the activated gas through a heat exchanger, which is in contact with liquid nitrogen at a slightly lower pressure than the activated gas, where it liquefies and subsequently moves slowly through a long path. With this method, the storage and shielding requirements are reduced by orders of magnitude to practical levels.

49251 Design of Fire/Gas Penetration Seals and fire exposure tests for Tokamak Fusion Test Reactor experimental areas. Cavalluzzo, S. (Princeton Plasma Physics Laboratory, Princeton, New Jersey). pp 1257-1259 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A Fire/Gas Penetration Seal is required in every penetration through the walls and ceilings into the Test Cell housing the Tokamak Fusion Test Reactor (TFTR), as well as other adjacent areas to protect the TFTR from fire damage. The penetrations are used for field coil lead stems, diagnostics systems, utilities, cables, trays, mechanical devices, electrical conduits, vacuum liner, air conditioning ducts, water pipes, and gas pipes. The function of the Fire/Gas Penetration Seals is to prevent the passage of fire and products of combustion through penetrations for a period of time up to three hours and remain structurally intact during fire exposure. The Penetration Seal must withstand, without rupture, a fire hose water stream directed at the hot surface. There are over 3000 penetrations ranging in size from several square inches to 100 square feet, and classified into 90 different types. The material used to construct the Fire/Gas Penetration Seals consist of a single and a two-component room temperature vulcanizing (RTV) silicone rubber compound. Miscellaneous materials such as alumina silica refractory fibers in board, blanket and fiber forms are also used in the construction and assembly of the Seals. This paper describes some of the penetration seals and the test procedures used to perform the three-hour fire exposure tests to demonstrate the adequacy of the seals.

49252 Mirror Advanced Reactor Study (MARS). Henning, C.D.; Bilton, J.R.; Campbell, R.B.; Carlson, G.A.; Glancy, J.E.; Gordon, J.D.; Herberman, R.J.; Kulcinski, G.L.; Logan, B.G.; Parmer, J.F. (Lawrence Livermore National Laboratory, Univ. of California, Livermore, CA). pp 1314-1320 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The Mirror Advanced Reactor Study (MARS) has resulted in an overview of a first-generation tandem mirror reactor. The central cell fusion plasma is self-sustained by alpha heating (ignition), while electron-cyclotron resonance heating and negative ion beams maintain the electrostatic confining potentials in the end plugs. Plug injection power is reduced by the use of high-field choke coils and thermal barriers, concepts to be tested in the Tandem Mirror Experiment-Upgrade (TMX-U) and Mirror Fusion Test Facility (MFTF-B) at Lawrence Livermore National Laboratory. Notable improvements in the reactor concept include radial drift pumping in the transition region between the central cell and end plug region and a much smaller direct converter. The drift pumping replaces neutral beam charge-exchange pumping and results in a high reactor energy multiplication factor ($Q=26$) and a low-recirculating power fraction (20%). The small direct converter has a central region to decelerate electrons and an annular region outside to receive and pump ions, impurity, and alpha ash from the halo, which encircles the fusion plasma. No grid wires are necessary, so that higher power density is achieved with no radial expansion of the magnet vacuum tanks to enclose the direct converter. The tritium inventory in MARS is less than 1 K because of the lithium lead blanket, halo pump, and fast-cycling cryo-vacuum pumps. Low-activation structures, together with free convection cooling of the blanket in the event of a loss-of-flow accident enhance the reactor environmental and safety aspects.

49253 Assembly of the TFTR vacuum vessel bellow cover plates. Kaminsky, E.L. (Princeton Univ., Plasma Physics Laboratory, Princeton, NJ). pp 961 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The Princeton Plasma Physics Laboratory (PPPL) Tokamak Fusion Test Reactor (TFTR) Vacuum Vessel is composed of ten segments. Each segment is separated by a bellows that provides structural integrity for the vessel and a finely-tuned electrical resistance in the toroidal direction. The bellows are made from 0.03 inch thick Inconel 625. During operations, they are subjected to a temperature of approximately 100°C. They are also exposed to neutron bombardment during plasma operation. To ensure their protection from bombardment, cover plates were designed to remove major particles directed at the bellows.

49254 Installation of the TFTR vacuum vessel bellows cover plates. Kaminsky, E.L.; Barnes, C.; Jensen, R.A.; Owens, D.K. (Princeton Univ., Plasma Physics Laboratory, Princeton, NJ). pp 962-966 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The stationary Bellows Cover Plates used to protect the TFTR vacuum vessel from hostile first wall thermal and particle environments were installed during the summer of 1983. This paper describes the installation process, including the staging prior to installation, the design of the handling fixtures, the sequence of installation and the detailed installation procedure. Fit-up difficulties encountered are discussed. The Bellows Cover Plates were fabricated from Inconel X-750 or Type 304 stainless steel, depending on location inside the vacuum vessel. All Inconel plates were instrumented with thermocouples. A total of 20 internal B-θ coils were installed on 12 of the plates. This instrumentation required the use of a turnover fixture. The weight or location of most of the plates precluded lifting the plates into position by hand, and therefore a number of inexpensive handling fixtures were designed and fabricated. This tooling maximized man-in-the-loop while providing closely controlled rotational and translational capability as the plates were moved from the entry port to the installation position, maneuvered into place and fastened to the vacuum vessel. A work platform was installed inside the vacuum vessel to permit movement of the plates and to serve as a tooling foundation. Magnetic and geometric measurements made on the vacuum vessel mounting brackets determined the shim thicknesses at the plate mounts which assured correct location of each Bellows Cover Plate from the toroidal centerline of the vacuum vessel. Prior to installation, out-of-alignment of some of these brackets was repaired. Two crews, one installing in a clockwise direction from the entry port and the other counterclockwise, installed the 130 plates in a 6-week period.

49255 Linear buckling analysis of the Big Dee Vacuum Vessel. Lichtner, S.S.; Gallix, R. (GA Technologies Inc., San Diego, CA). pp 967-972 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A simplified three-dimensional shell buckling analysis of the GA Technologies Inc., Big Dee Vacuum Vessel (V/V) was performed using the finite element program TRICO. A coarse-mesh linear elastic model, which accommodated the support boundary conditions, was used to determine the buckling mode shape under a uniform external pressure. Using this buckling mode shape, refined models were used to calculate the linear buckling load (P /SUB crit/) more accurately. Several different designs of the Big Dee V/

V were considered in this analysis. The supports for the V/V were equally-spaced radial pins at the outer diameter of the mid-plane. For all the cases considered, the buckling mode was axisymmetric in the toroidal direction. Therefore, it was possible to use only a small angular sector of a toric shell for the refined analysis. P /SUB crit/ for the Big Dee is about 60 atm for a uniform external pressure. Also investigated in this analysis were the effects of geometrical imperfections and non-uniform pressure distributions. The V/V is insensitive to geometrical imperfections, and a buckling load factor of 31 was found for a static nonuniform pressure distribution using the peak pressures from a 5 MA plasma disruption. The buckling load factors found in this preliminary analysis were for the V/V without ports.

49256 **Construction of the JFT-2M Tokamak(3) — development of semiconductor shunt resistor —.** Yamada, M.; Kasai, M.; Kuwai, Y.; Uchikawa, T. (Mitsubishi Atomic Power Ind., Tokyo). pp 973-977 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A new type of toroidal shunt (by-pass) resistors have been successfully developed for the JFT-2M vacuum vessel. Since the vacuum vessel is electrically insulated at two toroidal positions with organic insulators, in-vacuum shunt resistors are required in order to prevent arc discharge at the insulated vessel joint and to protect the in-vessel magnetic probes and the poloidal field (PF) coils in case of plasma disruptions or misfire. Approximately 10 mΩ toroidal resistance is necessary based on the PF coils and power supply design conditions. For the resistors, metals can not be used because of their higher electric conductivity and small heat capability, and finally newly developed SiC ceramic has been chosen due to its moderate electric conductivity, high thermal conductivity and sufficient mechanical strength. Fifty-two cylindrical SiC pieces are built in the fastening bolts for each of the insulated vessel joints. The SiC ceramic used here has Zennercharacteristics, i.e., its conductivity rapidly decreases with the increment of applied voltage, thus it presents preferable performances in terms of providing a high toroidal resistance at plasma start-up and a lower one at disruptive plasma behavior. The plasma operation of about 4900 discharges performed so far has shown the effectiveness and applicability of this type of shunt resistors. This work has been done under the contract from JAERI and provided with a number of useful advices and suggestions by JAERI members.

49257 **Construction of the JFT-2M Tokamak(2) design and fabrication of a vacuum vessel.** Uchikawa, T.; Ioki, K.; Kuri, S.; Kuribayashi, S.; Yamada, M. (Mitsubishi Heavy Industries, Kobe). pp 978-982 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The newly constructed JFT-2M tokamak has a D-shaped vacuum vessel made of 25 mm thick stainless steel. The size of the minor cross section of the vessel is 1.19 m vertical and 0.86 m horizontal in inner diameter. To comply with the requirements of dimensional accuracy and high vacuum performance, the vacuum vessel has been fabricated by applying newly developed fabrication techniques such as large scale gross press forming, local vacuum electron beam welding, three-dimensional automatic welding of ports. The vacuum vessel also features a number of large diagnostic ports, toroidal resistance due to PTFE (Teflon) insulators with shunt (by-pass) resistors, a large amount of internals including various types of magnetic probes. The structure analyses were performed by using the FEM code, NASTRAN. The results concluded that the stress intensities and displacements for the vessel caused by the combined loads of atmospheric pressure, gravity, and electromagnetic forces were within the allowable levels. The vacuum tests before and after 120°C baking proved integrity of the vacuum boundary with satisfactory vacuum pressure obtained.

49258 **Design description of the vacuum vessel for the Advanced Toroidal Facility.** Chipley, K.K.; Nelson, B.E.; Vinyard, L.M.; Williamson, D.E. (Oak Ridge National Laboratory, Oak Ridge, TN). pp 993-995 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The Advanced Toroidal Facility (ATF) will be a stellarator experiment to investigate improvements in toroidal confinement. The vacuum vessel for this facility will provide the appropriate evacuated region for plasma containment within the helical field (HF) coils. The vessel is designed to provide the maximum reasonable volume inside the HF coils and to provide the maximum reasonable access for future diagnostics. The vacuum vessel design is at an early phase and all of the details have not been completed. The heat transfer analysis and stress analysis completed during the conceptual design indicate that the vessel will not change drastically.

49259 **Vacuum vessel installation in the TFTR.** Spinos, F. (Grumman Aerospace Corp., Bethpaye, NY). pp 1117-1119 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The vacuum torus for the Tokamak Fusion Test Reactor was designed and fabricated in ten separate segments that were fitted in the Tokamak individually, joined and welded to complete the toroid. The method of dimension control during fabrication as it related to installation, the positioning of the segments in the tokamak, the alignment of the vacuum vessel in relation to the machine center, the welding process used and the final adjustment of the vessel support columns are addressed in this discussion. Installation of the Torus Vacuum Pumping System and the initial pump down of the vacuum vessel are also explained. A ten segmented torus was chosen for the Tokamak Fusion Test Reactor at Princeton. The materials selected were 304 and 304 LN stainless steels for the major structure and inconel 625 for the integral bellows section. The torus segments were of three basic designs. Various configurations of access ports were designed to meet the overall requirement for heating and cooling, neutral beam attachment, limiter installation and diagnostic penetrations. The vacuum enclosure was designed to be baked to 250°C at various times during the machine operational schedule; additional heaters and overall insulation were added once the segments were received at Princeton. A bake out temperature of 100°C has been achieved as of this writing. A leak check of each individual segment was also performed prior to installation as part of the reactor. The discussion that follows is a brief description of the method used to receive the vessel segments in the test cell and install them on the machine floor to form the completed torus.

49260 **Verification of the hydraulic design of the FMIT liquid lithium target.** Miles, R.R.; Annese, C.E.; Ingham, J.G. pp 1120-1123 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A liquid lithium target is being developed to generate a neutron flux for material testing in a fusion-like environment. The target consists of a thin, high speed, curved wall jet of lithium which is formed by an asymmetric nozzle. A prototype target was designed using potential flow analysis and was tested in water. Measurements of jet thickness and velocity in water and thickness in lithium were compared with isothermal design predictions and were shown to match within 1% for thickness and 5% for jet velocity.

49261 **Thermal fatigue behaviour of materials for fusion device applications.** Kaneko, O.; Kimura, K.; Kuroda, T.; Ohmori, J.; Oka, Y.; Sakurai, K.; Sawadu, Y.; Sibui, M. (Inst. of Plasma Physics Nagoya Univ., Nagoya). pp 1003-1106 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Since many components of fusion devices are subjected to critical cyclic heat loadings, lifetime prediction of these components has become an area of high interest. This paper presents a method for estimating thermal fatigue life of a silver bearing copper plate subjected to severe cyclic heat loadings on its surface. To demonstrate the above method, elastic plastic stress analyses and material test are performed. Damage due to thermal fatigue is expressed in term of hysteresis energy which enables to eliminate temperature considerations on lifetime equations. Damaged area is determined using experimental data on thermal fatigue, and then possibility of its propagation is examined. The material test apparatus is also described which allows thermal cycling test up to 2400 kW - 1 sec. The heat source is offered by Institute of Plasma Physics, Nagoya University.

49262 **TFTR bumper limiter design.** Sevier, L.; Bialek, J.; Citrolo, J.; Ho, M.F.; Weissenburger, D.; Zatz, I. (GA Technologies, San Diego, CA). pp 1072-1076 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The Tokamak Fusion Test Reactor (TFTR) Bumper Limiter will provide protection of the inner vacuum vessel wall from the normal operational plasma flux densities of up to 420 W/cm^2, local diagnostic neutral beam depositions of 1.2 kW/cm^2, and predicted disruptive instabilities of up to 100 kW/cm^2. The limiter incorporates a frontal surface area of approximately 22 m^2 of titanium carbide coated graphite tiles restrained against cooled Inconel support plates. The limiter concept is driven by both the thermal and electromechanical design loads. Thermal analysis demonstrates that cool-down is accomplished within the required 300 sec repetition rate for normal operation. Electro-mechanical loadings have been minimized to acceptable levels through material selection, geometry modification, electrical isolation and increases in the flexibilities of the limiter to vessel connections.

49263 **TFTR movable limiter installation.** Frankenberg, J.; Collins, D.; Jensen, R.A.; McDade, J. (Princeton Plasma Physics Laboratory, Princeton Univ., Princeton, NJ). pp 1077-1080 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The TFTR movable limiter is a poloidal limiter consisting of graphite tiles mounted on three blades with hinge connections supported by three independent actuators. The installed configuration is shown. The blades and actuators underwent mechanical, electrical and vacuum tests at the fabricator and at PPL prior to assembly with the TFTR vacuum vessel. During the preparation phase the installation crew removed the bus bar segments and air ducts that interfered with assembly and installed the support steel and the support table for the blade fixture. The actuators were assembled with the extension tubes and motor drives. The lower vertical actuator was rolled into the basement on carts, then pulled into position by a cable through the vacuum vessel. The upper vertical actuator was installed next by lowering into position from above. The three blades (with most of the graphite tiles installed), the cover plate, the horizontal actuator and water and instrumentation feedthroughs were mounted on an air cushion installation fixture, which was then lowered onto the support table. The assembly was floated into position with hand adjustment to engage the roller assemblies with the limiter bridges and the guide pins into the vacuum vessel. The cover plate was then bolted onto the vacuum vessel and the remaining graphite tiles are installed. The whole assembly underwent final adjustment and calibration after installation in the vacuum vessel.

49264 **Operational experience and initial performance of the TFTR vacuum system.** Krawchuk, R.B.; Blanchard, W.R.; Dylla, H.F.; Persons, R.; Sredniawski, J.J.; Ward, C. (Princeton Plasma Physics Laboratory, Princeton, New Jersey). pp 1081-1087 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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This paper describes the operational experience with the Tokamak Fusion Test Reactor (TFTR) vacuum system and its performance characteristics since its initial operation in October 1982. The TFTR vacuum vessel and the Torus Vacuum Pumping System (TVPS) high vacuum ducts contain a volume of 86.5 m^3 and a surface area of approximately 200 m^2. The primary materials exposed to vacuum in this system which is a completely metal sealed system with the exception of internal valve seals, are 304LN stainless steel in the torus structure and the vacuum ducts, Inconel 625 in the torus bellows, and graphite in the plasma limiters. Two 1 m diameter ceramic-to-metal sealed electrical breaks in the pumping ducts isolate the TVPS from the torus. High vacuum pumping of the torus is provided by eight nominally 3500 liter/sec turbo-molecular pumps (TMP's) and Zr/Al surface pumping panels which became operational in November 1983. Two 10,000 liter/sec cryo-pumps will provide additional pumping capability in 1985. The TVPS is controlled by a local microprocessor and programmable controllers with operating and monitoring capability provided through the TFTR central computer system. Pressure measurement instrumentation for characterizing the vacuum system performance includes a fast response ion gauge system for pumping speed measurements, capacitance manometers for pressure calibration, and residual gas analyzers for partial pressure measurements.

49265 **Three-dimensional analysis of contact conditions in the TFTR limiter tiles.** Pelessone, D.; Smith, P.D. (GA Technologies Inc., San Diego, CA). pp 1088-1092 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The graphite tiles for the limiters of the TFTR are attached to water-cooled Inconel backup plates using a T-shaped bar that is situated in a slot in the graphite. During the pulsed heating of the limiter surface, the tile tends to bow, and interaction of the tile with the T-bar causes tensile stresses in the root of the slot. These are the dominant stresses for the design of the limiter. The stresses in the T-bar slot depend on the contact conditions between the tile and the backup plate and between the T-bar and the slot. A three-dimensional analysis, reported herein, was undertaken to determine the contact conditions in some detail. The analysis was performed using finite element programs that were developed at GA Technologies for the nonlinear thermal and stress analysis of threedimensional solids. These programs, HEAT3 and THREED, have two attributes that were useful in this application: numerical efficiency and a general-purpose material interface. The contact conditions were modeled by means of a nonlinear gap material having discontinuous, anisotropic stress-strain behavior. This technique proved to be effective, stable, and rapidly converging. The results of the analysis showed that three-dimensional effects are important. The contact conditions cannot be modeled adequately in only two dimensions because variations along the length of the bar and torque in the bar are significant. The largest tensile stress in the graphite predicted by the 3-D analysis was 42% larger than that predicted by a 2-D analysis.

49266 **Thermal and structural nonlinear analysis of the Ignitor plasma chamber.** Terry, R.A.; Nyden, I.J.; Titus, P.H. (Stone and Webster Eng. Corp., Boston, MA). pp 1093-1098 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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This paper discusses load sources and stress analysis of the first wall of the Ignitor fusion device. Specific analysis aspects covered are: (1) Heat fluxes in the throat region of the plasma chamber are determined as a function of time and plasma shape; (2) The time-temperature distribution for the plasma chamber, due to plasma contact and radiation effects, is determined; and (3) Vacuum loads, electromagnetic operating loads, and two different temperature distributions are used with the ANSYS finite element code to assess the structural adequacy of the chamber. In addition to the structural analysis, a parametric study on the gap/interference between the chamber and the surrounding toroidal field (TF) coil was conducted to establish its effect on the stress condition. This step is necessary to establish fabrication tolerances and acceptable limits of TF coil deformation. The chamber boundary conditions are varied by adjusting the gap size of the nonlinear spring elements used to model These gapped elements resist expansion of the chamber wall and provide frictional resistance to sliding without fixing boundaries or inhibiting inward deflections. Stress results and exaggerated deformation plots are presented for the various cases.

49267 Pre-assembly of TFTR vacuum vessel. Jensen, R.A.; Mullaney, D.H.; Rappe, G.H. (Burns and Roe Inc., Princeton, NJ). pp 1053-1057 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A description of the work performed on the vacuum vessel following receipt from Chicago Bridge and Iron (CB & I), until installation on the machine floor is given. The work includes mechanical and instrumentation additions; mechanical, heating/cooling, vacuum, and electrical resistance testing; vessel cleaning; and vessel handling. The vessel was placed on a stand to facilitate polishing and inspection of vacuum seal surfaces. In parallel, port cover plates were modified because the sealing surface on the outside face provided by the factory cut the rubber "O" rings of the secondary seal during the first tries at installation. The port covers were then trial fitted on the appropriate vessel nozzle, and bolt holes enlarged as needed. The vessel and covers were cleaned with steam, dried, and wiped with lint-free rags and alcohol. Covers including hard seals were installed on the vessel and bolts torqued to specs. Seals were leak checked by evacuating the seal interspace and introducing helium around the seals. The heating/cooling system which consists of air flow channels on the vessel shell, was then balanced. Instrumentation including B-θ loops, thermocouples and strain gages were added to the vessel. The vessel segment was put on the vacuum test stand, blanked off and suitably bagged. The vessel was evacuated and helium introduced into the bags and heating/cooling system. A mass spectrometer attached to the vacuum pumping system indicated the presence of leaks. Leaks were corrected and the vessel retested. The only serious leak found was due to a bellows containing two cracks. Vessel segments were moved to another area where the vessel's thermal insulation was added. On completion, each segment was fitted into a special transport fixture and shipped to the Tokamak Assembly Area.

49268 Reliability tests of 40 CM ID all metal gate valve and 54 CM ID ceramic break for JT-60. Ogiwara, N.; Arai, T.; Kimijima, H.; Shimizu, M.; Takizawa, T. (Japan Atomi Energy Research Inst.). pp 1058-1062 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The present paper describes the results of reliability tests for 40 cm inner diameter (ID) all metal gate valve (AMGV) and 54 cm ID ceramic break (CB) used in JT-60 vacuum pumping system. Thirty six AMGVs are used above turbomolecular pumps (TMP) and sputter ion pumps (SIP), and the vacuum pumping system is electrically isolated by 4 CBs from a vacuum vessel. Reliability tests of both components have been carried out before the construction of the system. Test results for AMGV show that (1) its life is over 10^3 cycles with the leak rate through the seat less than 1.3×10^{-6} Pa.m^3/s, that (2) its bakeable temperature is up to 300°C, and that (3) it has enough toughness under 1 G acceleration. On the other hand, the test results for CB show that it has enough strength against the external force such as magnetic force under a room temperature and the electrical isolation of 1.1 kV A.C. has been confirmed sometimes during the tests. These fruitful results show assurance of reliability for 40 cm ID AMGV and 54 cm ID CB for use in JT-60 vacuum pumping system.

49269 Tandem Mirror Experiment-Upgrade vacuum system-a new configuration and operating parameters. Lang, D.D.; Calderon, M.D.; Hunt, A.L.; Nexsen, W.E.; Pickles, W.L.; Turner, W.C. (Lawrence Livermore National Laboratory, Livermore, CA). pp 1063-1067 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The Tandem Mirror Experiment-Upgrage (TMX-U) vacuum system has been installed and operating since December 1981. In 1982 and early 1983 the performance of the internal, dynamic pumping system was evaluated during physics experiments. The plasma region gas loads caused the pressure to exceed that allowable for achieving thermal barrier plasmas. The unified, multiple-beamline concept used on TMX-U to pump the neutral-beam injector gas was modified. The modifications to the system were designed to reduce conductance between the injectors and the plasma region to better use the differential pumping in the pumping regions. The modifications made were a smaller cross section neutralizer, replacing apertures with ducts between regions, eliminating the injector scrape-off in the plasma region, relocating the neutral beam dumps, and eliminating the gaps around various penetrations. These changes have resulted in reducing the maximum measured pressure in the plasma region during a discharge from 3×10^{-6} to 4×10^{-7} Torr. This corresponds to a change in the maximum pressure at the plasma edge from 6×10^{-6} to 9×10^{-7} Torr during a discharge. In addition to the improvements made to the internal pumping regions, reductions were made in the wall reflux that occurs during a plasma discharge as a result of chargeexchange particles coming out of the plasma. In TMX-U we provide clean, titanium-coated walls around the plasma to limit the wall reflux. The uniformity and total coverage of this coating were improved by increasing the number of getters in the plasma region and improving the reliability of the existing getters by eliminating internal shorts. The estimated wall reflux rate (thermal molecules off of the wall/energetic atoms into the wall) dropped 30% after the modifications were incorporated.

49270 Test results for a C+SiC alloy coating on limiter/armor tiles in Doublet III. Hopkins, G.R.; Kaae, J.L.; Trester, P.W. (GA Technologies Inc., San Diego, CA). pp 1068-1071 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A new carbon plus silicon carbide (C+SiC) alloy material has been developed for use on in-vessel components of plasma devices. This material is nominally 10 wt % SiC and is applied as a coating to graphite substrates. It has been tested in the limiter/beam armor position of Doublet III for over 11,000 plasma shots. The performance is excellent and the material is highly resistant to thermal shocks, thermal cycling and erosion from plasma boundary and neutral beam interactions. This promises a long useful life for components in fusion vessels.

49271 A stellarator helical vacuum vessel. Yavornik, E.J. (Los Alamos National Laboratory, Los Alamos, NM). pp 1031-1033 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A design study of a stainless steel, heavy wall, helically shaped vacuum torus has been made for use in a proposed Stellarator configuration. The study concerns itself with the shape of the vacuum vessel and the division of the vessel into components that can be machined and welded together into a helical configuration. A complication in the design requires that a circular magnet coil be located at the minor toroidal axis and that this coil be embedded within the periphery of the vacuum vessel. The vacuum vessel has a minor toroidal axis diameter of 4 meters, a 68.6-cm shell diameter, and a 1.9-cm wall thickness. It twists about the minor toroidal axis twice in 360°. (An n value of 2). It is proposed that the unit be made of cylindrical segments with the ends of the cylinders cut at appropriate lengths and angles to form the helix. A mathematical derivation of the dimensions necessary to produce the required shapes of the segments has been made. Also, drawings of the vacuum vessel components have been produced on LANL's CTR CAD/CAM system. The procedure developed can be used for any value of n as dictated by physics requirements.

49272 **Fabrication of JT-60 vacuum vessel.** Sato, H.; Kajiura, S.; Kanamori, M.; Karastu, N.; Ohta, M.; Owada, K.; Sasajima, H.; Shimizu, M.; Yamamoto, M. (Hitachi Works Hitachi Ltd., Hitachi). pp 1034-1037 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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JT-60 is an experimental tokamak device for the investigation of reactor grade plasma. The design and various model tests on the JT-60 vacuum vessel had been finished. Then based on the results the vessel was fabricated and tested on many kinds of characteristics and specifications. This paper describes the design parameters and fabrication procedure of the vessel prior to the construction at the site.

49273 **Final design and fabrication of the moveable limiter for TFTR.** McKelvey, T.; Johnson, E.; Trester, P.W. (GA Technologies, San Diego, CA). pp 1043-1047 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A moveable poloidal limiter system has been designed and built for installation in the Tokamak Fusion Test Reactor at the Princeton Plasma Physics Laboratory. The limiter system consists of three blades which are made of Inconel and are covered with TiC-coated POCO AXF-5Q graphite tiles. The Inconel structure is water cooled and instrumented with spring loaded thermocouples in contact with the graphite tiles. Each blade is supported by a screw actuator. The vertical blade is held rigidly while the upper and lower blades, which pivot from the vertical blade, are held by roller bearings. The blade movements allow experiments to be conducted with a wide variety of plasma major and minor diameters. Limiter tile surface area and graphite tile shape were designed for a 4 MW ohmically heated plasma (energy flux density at limiter surface of 850 W/cm^2 for 1.5s) and for a 33 MW neutral beam heated plasma (7kW/cm^2 at the limiter for 0.1s). The latter case produces the highest tile stresses. Design strength of most of the remaining limiter system components resulted from consideration of dynamic loading during fault current flow through the system and during plasma disruptions. Fabrication procedures, such as welding, heat treating, TiC coating of graphite, Ni plating, water tube brazing and plasma spray coating were carefully controlled through appropriate testing and process control coupons. The possibility of galling and/or fretting at bearing surfaces was addressed by a test program where a plasma sprayed alumina-titania coating was evaluated. Design of the vertical blade (a composite beam) and solutions to other design problems such as: tile attachment to blades, roller assembly design, blade pivot design and thermocouple design are discussed in detail.

49274 **Mechanical strength evaluation of the welded bellows for the ports of the JT-60 vacuum vessel.** Takatso, H.; Shimizu, M.; Yamamoto, M. (Japan Atomic Energy Research Inst.). pp 1048-1052 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Mechanical strength of the welded bellows for the ports of the JT-60 vacuum vessel was evaluated, laying the emphasis on the fatigue strength under the torsional electromagnetic force. The welded bellows were designed to be loaded with the forced deflection due to the relative displacement between the vacuum vessel and the external fixed point, the atmospheric pressure and the forced torsional angle due to the electromagnetic force. Stresses caused by the former two were estimated following the formulae proposed by the Kellogg Company. On the other hand, two formulae were established to estimate the stress caused by the last, after examining experimentally the behavior of the welded bellows under the torsional load; one is the shearing stress evaluation formula and the other is the axial bending stress evaluation formula. It was found that the welded bellows can easily buckle under the torsional load and the former formula corresponds to the case of non-buckling and the latter to the case of buckling. The present mechanical strength evaluation method was applied to the three kinds of the welded bellows to be used in the ports of the JT-60 vacuum vessel (neutral beam injection ports, vacuum pumping ports and the adjustable limiter ports) and it was confirmed that they have sufficient strength in the range of the design load conditions.

49275 **Electromagnetic characteristics and loadings of the Tokamak de Varennes vacuum vessel.** Kalnavarns, J.; Leclair, G.; Vanandel, M. (MPB Technologies Inc., Dorval, Quebec). pp 1017-1021 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A circuit model for the vacuum vessel of the Tokamak de Varennes is formulated and the diffusion of applied magnetic fields is analyzed using eigenfunction techniques. The dominant eddy current modes are examined and the wall resistances chosen, subject to structural constraints, to minimize the characteristic time constants. The distribution of wall thicknesses for an Inconel shell corresponding to a 2 ms penetration time for the vertical field can withstand the loadings due to atmospheric pressure with superimposed forces arising from the currents induced by a hard plasma disruption.

49276 **Design, fabrication, and installation of the TFTR Prototype surface pumping system.** Srediawski, J.J.; Cecchi, J.L.; Mueller, J. (Grumman Aerospace Co., Forrestal Campus, Princeton, NJ). pp 996 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The TFTR surface pumping system in its full remote handling version has been previously described. Due to funding constraints the installation of such a system was postponed to early 1985. For the interim period (1983-85) a smaller version requiring no remote maintenance has been installed. This system uses eight pumping panels concentrated near the movable limiter inside the torus vacuum vessel. These panels utilize the same Zirconium/Aluminum getter material as the full system. It is the purpose of this paper to describe the system as it presently exists in TFTR, and some of the more important fabrication steps. A comparison of predicted and measured performance parameters is included. A future modification which will incorporate neutralizer plates for improved particle capture is also described.

49277 **Vacuum vessel and nuclear shielding design for the MFTF-α+T.** Krichner. (Oak Ridge National Laboratory, Oak Ridge, TN). pp 997-1001 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The α+T configuration is an upgrade of the Mirror Fusion Test Facility (MFTF-B) presently under construction at the Lawrence Livermore National Laboratory (LLNL) in California. The purpose of the MFTF-α+T fusion device is to advance plasma confinement with deuterium-tritium (D-T) burning plasma and system integration in the nuclear environment of a reactor. The vacuum vessel of the α+T device, which provides the required vacuum environment for the plasma, is the primary load-carrying structure. It consists primarily of a three-piece, cylindrical shell with domed ends and maintenance access hatches.

49278 **Development of a large Lithium Coolant System for coolant under vacuum.** Kolowith, R.; Berg, J.D.; Meadow, G.E.; Schwartz, K.E. (Hanford Eng. Development Laboratory, Richland, WA). pp 1002-1007 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Argon and vacuum systems for the Experimental Lithium System (ELS) were tested to demonstrate vacuum break capability, vacuum pumping performance, and vacuum sensor compatibility with a hostile liquid metal vapor/aerosol environment. Mechanical, diffusion and cryogenic vacuum pumps were evaluated. High vacuum levels in the 10^{-3} Pa range were achieved over a 270°C flowing lithium system. Ionization, thermal conductivity, capacitance manometer, and compound-type pressure sensors were evaluated to determine the effects of this potentially deleterious environment. Screening elbows were evaluated as pressure sensor protective devices. A dual-purpose vacuum-level/nitrogen partial-pressure sensor was evaluated as a means of detecting air in-leakage. Several types of static mechanical vacuum seals were also evaluated. Measurements of the vapor/aerosol generation were made at several system locations and operating conditions.

49279 **Doublett III limiter/armor update.** Johnson, E.; McKelvey, T.; Morrill, W.; Phelps, R.; Stambaugh, R. (GA Technologies, San Diego, CA). pp 1014-1016 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The Doublet III device is operating with an extensive system of plasma limiters and wall protective armor. Operations with up to 8MW of neutral beam power and 1.5MA plasma current are planned. Design and operational performance of the following systems are discussed: 1. Water-cooled graphite moveable limiter 2. Water-cooled graphite fixed limiter and neutral beam wall armor. 3. Radiatively cooled Inconel divertor plates.

49280 **An enhancement to the Tektronix PLOT-10 Terminal Control System for Creation of Graphics Metafiles.** Gray, W.H. (Fusion Energy Division Oak Ridge National Lab., Oak Ridge, TN). pp 496-500 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Many data handling and analysis codes at the Oak Ridge National Laboratory (ORNL) use the Tektronix PLOT-10 Terminal Control System to graphically display data upon Tektronix or Tektronixemulating graphics devices. Prior to the development of the software libraries and postprocessors discussed within this report, ORNL users were limited to the type of hardcopy output obtainable from the Tektronix PLOT10 software library. Only Tektronix graphics devices are supported by the PLOT-10 library. The graphics library presented here eliminates this restriction by implementing a suite of software that optionally creates a graphics metafile within the user's disk area while simultaneously drawing a display image on the screen of a user's Tektronix terminal. This graphics metafile can then be postprocessed onto any of the graphics devices at ORNL via the ORNL PLOT command.

49281 **TFTR master control and master clock system.** McEnerney, J.; Christianson, G.; Montague, J.; Moyer, D.; Son, H.; Stark, W.; Thompson, M. (Princeton University, Princeton Plasma Physics Laboratory, Princeton, NJ). pp 501-502 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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In order to coordinate the operation of TFTR, the computer system was required to allow the experimentalists to specify certain control parameters and waveforms (time vs. control setting) which are relevant to the production of TFTR discharges. These parameters comprise the Machine State Database (MSD). The Master Clock for sequencing TFTR was designed to support the phases of MSD decision, validation, and implementation with the ability to recycle should validation fail. The clock issues systems interrupts at each of these phases as well as at other times in order to trigger all the systems to operate simultaneously to produce the discharge. These interrupts also interface to the Event System which will trigger programs to run during various phases of the cycle.

49282 **A report on the experience with the Supervisory Control and Diagnostics System (SCDS) of MFTF-B.** Wyman, R.H. (Lawrence Livermore National Laboratory, Livermore, CA). pp 472-476 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The Supervisory Control and Diagnostics System (SCDS) of MFTF is a multiprocessor computer system using graphics oriented displays with touch sensitive panels as the primary operator interface. Late in the calendar year 1981 the system was used to control an integrated test of the vacuum vessel, vacuum system, cryogenics system and the superconducting magnet of MFTF. Since the completion of those tests and starting in early calendar 1983 the system has been used for control of the neutral beam test facility at LLNL. This paper presents a short overview of SCDS for the purpose of orientation and then proceeds to describe the difficulties encountered in these preliminary encounters with reality. The band-aids used to hold things together as disaster threatened as well as the long-term solutions to the problems will be discussed. Finally, we will present some comments on system costs and management philosophy.

49283 **Automatic generation of computer programs servicing TFTR console displays.** Eisenberg, H. (Princeton Plasma Physics Laboratory, Princeton, NJ). pp 477-481 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A number of alternatives were considered in providing programs to support the several hundred displays required for control and monitoring of TFTR equipment. Since similar functions were performed, an automated method of creating programs was suggested. The complexity of a single program servicing as many as thirty consoles mitigated against that approach. Similarly, creation of a syntactic language while elegant, was deemed to be too time consuming, and had the disadvantage of requiring a working knowledge of the language on a programming level. It was elected to pursue a method of generating an individual program to service a particular display. A feasibility study was conducted and the Control and Monitor Display Generator system (CMDG) was developed. A Control and Monitor Display Service Program (CMDS) provides a means of performing monitor and control functions for devices associated with TFTR subsystems, as well as other user functions, via TFTR Control Consoles. This paper discusses the specific capabilities provided by CMDS in a usage context, as well as the mechanics of implementation.

49284 **Evolution paths of a general control system.** Speckert, G.C.L. (Lawrence Livermore National Laboratory, Livermore, CA). pp 482-485 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Large systems are built by teams of people who communicate through a set of design tools to produce an information model which describes the system. The model can be analyzed for consistency and completeness. A system building methodology based upon this information model can be used for the construction, operation, and maintenance of the system. Operational procedure knowledge derived from operating experience can be used for autonomous operation. Advancing computer technology is improving the engineering tools available in each of these areas. A unified set of such tools provides the maximum amount of computer assistance to the system builders.

49285 **Thermal-structural analysis of the TFTR vacuum vessel bellows.** Bialek, J. (Princeton Univ. Plasma Physics Lab., Princeton, NJ). pp 464-467 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The function of the bellows in the Tokamak Fusion Test Reactor (TFTR) vacuum vessel is to limit toroidal current flow in the vacuum vessel. This is accomplished by a bellows design that provides high electrical resistance. Fourteen bellows made of thin (.050") Inconel 625 have been located in series with the toroidal vacuum vessel shell. Since the vacuum vessel is constructed out of thick 304 LN stainless steel the operating envelope of the TFTR vacuum vessel is in part determined by the thermal stress problem that exists between the bellows and the stiff structural rings in the vacuum vessel. The thermal and mechanical analysis that was done to define that envelope is described in this paper.

49286 **Numerical analysis of a thermomechanical problem of the RFX experiment.** Majorana, C.E.; Odorizzi, S.A.; Schrefler, B.A. (Univ. of Padova). pp 459-463 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The local stress states of some structural components of the RFX experiment, like the vacuum vessel, are affected by thermal loads. In particular the residual stresses due to welding procedures during the manufacturing process may produce local embrittlement and, in general, weakening of the specimen, which can cause its failure. This fact was pointed out in experimental tests. For instance the bellows weld of the vacuum vessel was responsible for most of the damages which occured during tests and during the operational period of some liners. The choice of proper solutions of these structural problems as well as a control of the important welding parameters such as arc energy per unit length of the weld and the welding speed can be effectively aided by a computational study of the underlying thermomechanical problems. This study also gives additional test data which in general are limited because of the inherent experimental difficulties. In this paper a general numerical approach for the study of thermomechanical problems based on the finite element method is outlined. This procedure takes into account heat sources and heat transfer due to simultaneous conduction, convection, and radiation and allows for the determination of the residual stresses in a thermoelastic-viscoplastic continuum. The procedure is applied to the study of the residual stresses produced by the arc welded joint between the bellows and the flat section of the liner for the RFX experiment.

49287 **Development of charcoal sorbents for helium cryopumping.** Sedgley, D.W.; Batzer, T.H.; Call, W.R.; Tobin, A.G. (Grumman Aerospace Corporation, Bethpage, New York). pp 454-458 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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High vacuum adsorption of helium on activated charcoal at liquid helium temperatures has demonstrated the high specific pumping speeds needed for fusion power systems. However, this method of cryopumping has not been optimized. This paper describes the results of a program to evaluate the effects of different grades of charcoal as well as the effects of various charcoal bonding methods on helium pumping speed and capacity. Coal- and coconut-based charcoals were evaluated using various attachment techniques such as brazing, refractory ceramic adhesives and mechanical retention. Results suggest that both charcoal particle size and grade had a strong effect on pumping speed and capacity. Coconut-based charcoals appear to give superior overall characteristics compared to coal-based charcoals, while smaller particles give higher pumping speeds. Various bonding media and attachment methods have a measurable effect on helium pumping characteristics suggesting that thermal conductivity of the bond and good contact with the charcoal are key parameters. Additional test data show the results of pumping mixtures of helium and deuterium.

49288 **Mirror Fusion vacuum technology developments.** Batzer, T.H.; Call, W.R. (Lawrence Livermore National Laboratory, Univ. of California, Livermore, CA). pp 450-453 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Magnetic Mirror Fusion experiments, such as MFTF-B+T (Mirror Fusion Test Facility-B, Tritium Upgrade) and foreseeable follow-on devices, have operational and maintenance requirements that have not yet been fully demonstrated. Among those associated with vacuum technology are the very-high continuous-pumping speeds, 10^7 to 10^8 l/s for D_2, T_2 and, to a lesser extent, He; the early detection of water leaks from the very-high heat-flux neutral-beam dumps and the detection and location of leaks in the superconducting magnets not protected by guard vacuums. Possible solutions to these problems have been identified and considerable progress has been made toward successfully demonstrating their feasibility.

49289 **Design features of the vacuum vessel and cryopumping systems for MFTF-B Axicell.** Fleming, P.J.; Chronis, W.C. (PDM Corp., Pittsburgh, PA). pp 444-449 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The Mirror Fusion Test Facility (MFTF) Program was started at Lawrence Livermore National Laboratory (LLNL) in 1977 with the design and construction of a single-cell mirror facility intended to explore scaling laws and advance the technology of mirror fusion devices. In 1980, changes to this device were initiated in order to provide a major facility for large scale tandem mirror fusion experiments (MFTF-B). By 1982, further advancement of the goals of the project had brought about significant changes leading to the current MFTF-B Axicell configuration. Through all of these changes, as the program has grown, PittsburghDes Moines Corporation (PDM) and CVI Incorporated (CVI) have participated in close cooperation with LLNL to develop and construct a viable configuration and system that is in accordance with the program requirements. This paper presents a summary of the engineering and technological approaches necessary to meet the challenging requirements of this project. It has required the utilization of existing facilities while meeting the needs of the MFTF operating requirements which dictate the current configuration. The first portion of the paper describes the work done on the vessel followed by a discussion of the cryopumping system.

49290 **Compact fusion reactors availability analysis.** Dabiri, A.E.; May, R.F. (Science Applications Inc., La Jolla, CA). pp 433-436 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Compact fusion reactor maintenance approach was identified, and schedule maintenance downtime analysis was performed for d-t and d-d-fueled Compact Reversed-Field Pinch Reactors (CRFPR). The results were then compared against each other, as well as against the conventional tokamak reactor design (STARFIRE). The results indicate that the d-t/CRFPR design may realize a 20 percent increase in availability over the conventional design. This increase is attributed primarily to the ability of the compact reactor power core to be replaced as an integral unit as opposed to the power core sector disassembly requirements inherent in the conventional design.

49291 **Design of the drift pumping system for MFTF-α+T.** Metlzer, D.H. (Oak Ridge National Laboratory, Oak Ridge, TN). pp 550-553 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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Drift pumping in mirrors is a new concept (less than one year old). If it works, compared to charge-exchange pumping, it will simplify the MFTF-α+T interface and possibly reduce the circulating power required. From an engineering standpoint, it has some very demanding requirements in terms of power and bandwidth. This paper describes a design which satisfies these requirements. It also identifies a number of promising alternatives requiring investigation and verification.

49292 **Establishing software quality assurance.** Malsbury, J. (Plasma Physics Lab. Princeton Univ., Princeton, NJ). pp 522-524 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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This paper is concerned with four questions about establishing software QA: What is software QA? Why have software QA? What is the role of software QA? What is necessary to ensure the success of software QA?

49293 Assembly, commissioning and first operation of JET. Huguet, M. (JET Joint Undertaking, Abingdon, Oxfordshire). pp 834-842 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A brief summary of the work carried out during the construction phase of JET is first given. This period was successfully concluded due to the well timed delivery by industry of all the major parts of the machine and power supplies. This could be achieved because of the excellent technical co-operation between the JET team and the firms involved in construction work. The assembly of the JET machine started on site in January 1982 immediately after civil engineering work was completed. Great attention was devoted to the preparation of the vacuum vessel octants. After delivery, they were carefully cleaned, baked and leak tested at 500 °C, and then fitted with instrumentation, electrical heater cables and thermal insulation, in view of the bake-out of the complete vessel after final assembly.

49294 Firmware design of a microcomputer controlled diagnostic vacuum controller. Lawson, J.E. (Princeton University, Plasma Physics Laboratory, Princeton, NJ). pp 338-340 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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The diagnostic vacuum controller (DVC) in use on the TFTR and S-1 machines at Princeton is designed around the Intel 8749 microcomputer. An interpreter was designed to make the computer look like a specialized programmable controller with functions to perform Boolean algebra, simulate programmable timers and one-shots, measure the speed of a turbo-molecular pump and to provide a set of self-diagnostics. This approach was chosen to allow the required program to fit in the 2K bytes of ROM in the 8749 instead of the approximately 10K bytes some other methods might have required. The DVC operates on a 100 msec cycle. During each cycle, all of the inputs are read, the outputs calculated during the previous cycle are sent out, and a new set of outputs are calculated. This sequence allows the previous state of the system to be used in the calculation of the current state of the system.

49295 High speed, locally controlled data acquisition system for TFTR. Feng, H.K.; Bradish, G.J. (Plasma Physics Laboratory, Princeton University, Princeton, NJ 08544). pp 345-349 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

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A high speed, locally controlled, data acquisition and transmission system has been developed by the CICADA (Central Instrumentation Control and Data Acquisition) Group for extracting certain timecritical data during a TFTR pulse and passing it to the control room, 1000 feet distant, to satisfy realtime requirements of frequently sampled variables. The system is designed to utilize any or all of the standard CAMAC (Computer Automated Measurement and Control) modules now employed on the CAMAC links for retrieval of the main body of data, but to operate them in a much faster manner than in a standard CAMAC system. To do this, a pre-programmable ROM sequencer is employed as a controller to transmit commands to the modules at intervals down to one microsecond, replacing the usual CAMAC dedicated computer, and increasing the command rate by an order of magnitude over what could be sent down a Branch Highway. Data coming from any number of channels originating within a single CAMAC "crate" is then time-multiplexed and transmitted over a single conductor pair in bi-phase at a 2.5 MHz bit rate using Manchester coding techniques. Benefits gained from this approach include: Reduction in the number of conductors required, elimination of line-to-line skew found in parallel transmission systems, and the capability of being transformer coupled or transmitted over a fiber optic cable to avoid safety hazards and ground loops. The main application for this system so far has been as the feedback path in this closed loop control of currents through the Tokamak's field coils. The paper will treat the system's various applications.

49296 Hardware design of a microcomputer controlled diagnostic vacuum controller. Marsala, R.J. (Princeton University, Plasma Physics Laboratory, Princeton, NJ 08544). pp 341-344 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

The TFTR diagnostic vacuum controller (DVC) has been designed and built to control and monitor the pumps, valves and gauges which comprise a diagnostic vacuum system. The DVC is a microcomputer based self-contained controller with battery backup which may be controlled manually from front panel controls or remotely via CICADA. The DVC implements all pump and valve sequencing and provides protection against incorrect operation. There are presently two versions of the DVC operating on TFTR and a third version being used on the S-1 machine.

49297 Charge exchange neutral particle mass and energy analyzer for JT-60. Hayashi, K.; Hashimoto, K.; Maeda, M.; Miura, Y.; Nishitani, T.; Shiho, M.; Takeuchi, H. (Toshiba Corp.). pp 387-390 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

A charge exchange neutral particle mass and energy analyzer for JT-60, which analyzes H, D and He simultaneously up to the maximum energy 110 (keV), has been developed. The analyzer has 180 degree deflection magnet for momentum analysis and electrostatic deflector for mass analysis separately. In normal operation the magnetic field is 0.303 (Tesla) and the electric field is 1.65 x 10^5 (V/m). MCPs as detectors can be set up to 32 channels for each ion species.

49298 "Big Dee" upgrade of the Doublet III diagnostic data acquisition computer system. Mcharg, B.B. (GA Technologies, San Diego, CA). pp 382-386 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

The "Big Dee" upgrade of the Doublet III tokamak facility will begin operation in 1986 with an initial quantity of data expected to be 10 megabytes per shot and eventually attaining 20-25 megabytes per shot. This is in comparison to the 4-5 megabytes of data currently acquired. To handle this greater quantity of data and to serve physics needs for significantly improved between-shot processing of data will require a substantial upgrade of the existing data acquisition system. The key points of the philosophy that have been adopted for the upgraded system to handle the greater quantity of data are (1) preserve existing hardware, (2) preserve existing software; (3) configure the system in a modular fashion; and (4) distribute the data acquisition over multiple computers. The existing system using ModComp CLASSIC 16 bit minicomputers is capable of handling 5 megabytes of data per shot.

49299 Applications of small computers for systems control on the Tandem Mirror Experiment-Upgrade. Bork, R.G.; Kane, R.J.; Moore, T.L. (Lawrence Livermore National Laboratory, University of California, Livermore, CA). pp 377-379 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

Desktop computers operating into a CAMAC-based interface are used to control and monitor the operation of the various subsystems on the Tandem Mirror Experiment-Upgrade (TMX-U) at Lawrence Livermore National Laboratory (LLNL). Small computers offer several advantages: independent system operation and development is possible, a modifiable operator interface is provided, and control and monitoring capabilities can be expanded as required without making major software modifications. System availability and reliability can be increased using spare computers and subassemblies. In addition, TMX-U experience has shown that very high programming efficiency is possible. Less than 10 man-months of software development were required to bring eight systems to the present level. These systems include: shot sequencer/master timing, neutral beam control (four consoles), magnet power system control, ioncyclotron resonant heating (ICRH) control, thermocouple monitoring, getter system control, gas fueling system control, and electron-cyclotron resonant heating (ECRH) monitoring. Two additional computers are used to control the TMX-U neutral beam test stand and provide computer-aided repair/test and development of CAMAC modules. These machines are usually programmed in BASIC, but some codes have been interpreted into assembly language to increase speed. Details of the computer interfaces and system complexity are described as well as the evolution of the systems to their present states.

49300 **Construction of the JFT-2M TOKAMAK (6) design, fabrication and testing of noise prevention and grounding system.** Oyabu, I.; Hayashi, S. (Mitsubishi Electric Co., Kobe-city). pp 405-409 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

The JAERI JFT-2M TOKAMAK experimental device produces high-frequency noise from heating devices such as ICRH/NBI and generats induction noise from the toroidal field/poloidal field (TF/ PF) coil power supply and plasma. The coil power supply, control and instrumentation of the JFT-2M contain a number of low-voltage electronic circuits which are exposed to a high-noise environment. Accordingly, to prevent the possible erroneous operation of each unit resulting from noise, a preliminary test was conducted for the shielding system, wiring system, filter effects and grounding system. Design and manufacture of the device were completed based on the results of this test and then, various tests using the device were conducted in cooperation with JAERI.

49301 **Communication systems in JT-60 control.** Kimura, T.; Hosogane, N.; Kondo, I.; Kumahara, T.; Kurihara, K.; Yonekawa, I.; Yoshino, R. (Japan Atomic Energy Research Inst.). pp 398-404 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

A new concept in communication is applied to the JT-60 control system which handles a large amount of data for the plant support and monitoring and for the discharge control including plasma feedback control. The communication systems are characterized by 1) adoption of an efficient protocol in the central highways which are composed of dual serial CAMAC ones, 2) standardization of the protocol and data format between the central controller and each subsystem one, 3) adoption of a polling method for plant monitoring and of block transfer for discharge conditions and results, and 4) use of novel modules for the fast data transfer in the real-time systems. A compact tool has also been developed for testing the data communication.

49302 **Computer control of the titanium Getter system on the Tandem Mirror Experiment-Upgrade (TMX-U).** McAlice, A.J.; Bork, R.G.; Clower, C.A.; Lang, D.D.; Moore, T.L.; Pico, R.E. (Lawrence Livermore National Laboratory, Livermore, CA). pp 395-397 of Fusion engineering. Vol. 1. New York, NY, USA; I.E.E.E. (1983). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

Gettering has been a standard technique for achieving high-quality vacuum in fusion experiments for some time. On Lawrence Livermore National Laboratory's Tandem Mirror Experiment (TMX-U), an extensive gettering system is utilized with liquid-nitrogen-cooled panels to provide the fast pumping during each physics experiment. The getter wires are a 85% titanium and 15% tantalum alloy directly heated by an electrical current. TMX-U has 162 getter power-supply channels; each channel supplies approximately 106 A of regulated power to each getter for a 60-s cycle. In the vacuum vessel, the getter wires are organized into "poles" or arrays. On each pole there are six getter wires, each cabled to the exterior of the vessel. This arrangement allows the power supplies to be switched from getter wire to getter wire as the individual wires deteriorate after 200 to 300 gettering cycles and in this way, the system is effectively regettered without raising the vessel to atmospheric pressure for maintenance. To control the getter power supplies, the authors will install a computer system to operate the system and document the performance of each getter circuit. This computer system will control the 162 power supplies via a Computer Automated Measurement and Control (CAMAC) architecture with a fiber-optic serial highway. Getter wire history will be stored on the built-in 10 megabyte disc drive with new entries backed up daily on a floppy disc. Overall, this system will allow positive tracking of getter wire condition, document the total gettering performance, and predict getter maintenance/changeover cycles. How the authors will employ the computer system to enhance the getter system is the subject of this paper.

49303 **The fission-suppressed direct-enrichment (FSDE) fusion breeder concept.** Cheng, E.T.; Bullock, R.; Creelon, R.L.; Fench, H.; Maya, I.; Schultz, K.R.; Simnad, M.; Wong, C.C. (GA Technologies Inc., San Diego, CA). pp 1873-1877 of Fusion engineering. Vol. 2. New York, NY, USA; I.E.E.E. (1982). (CONF-831203—).

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

The development of fusion breeder designs has progressed so far that we can now see a number of advantages to be obtained by using the fission-suppressed concept as described previously. Among the advantages are high fissile fuel yield, rapid enrichment rate, very low fission product and actinide inventories, and low thermal power swing during enrichment. These features can translate into good economics, simple blanket design, low blanket failure probability, and favorable safety characteristics. A concern for all hybrid concepts is reprocessing. It can be expensive, adding up to $20/g or more to the cost of the bred fuel, and it forces fusion to either (a) wait for the fission industry to resolve the various fuel cycle issues it now faces and to implement reprocessing and recycle, or (b) develop unique reprocessing/refabrication facilities of its own, or possibly both of these.

99 GENERAL AND MISCELLANEOUS

9901 Management

REFER ALSO TO CITATION(S) 99010049323

49304 **(DOE/ET/10552—T1) Fossil energy program support to ERDA. Progress report, November 1-November 30, 1976.** (TRW, Inc., McLean, VA (USA). Energy Systems Planning Div.). Dec 1976. Contract AC01-76ET10552. 21p. NTIS, PC A02/MF A01; GPO Dep. File Number DE84017298.

Two revisions to Fossil Energy's 14 building blocks for the National Plan, Volume II (ERDA 77-1), were prepared and submitted on November 16 and 24. The draft report, Coal Conversion Plant Cost Escalation, was completed. Meetings were held with USGS, CER, BERC, Sandia, LLL, and ERDA Headquarters personnel as work continues on preparing a Preliminary Project Plan for the Western Gas Project. Preliminary value test conditions and facility development schedules were presented at a joint ERDA Headquarters/MERC meeting. A schedule analysis of the impact of adding the Division of Fossil Demonstration Plants' value test requirements was also presented. The Program Plan for Fossil Demonstration Plants was completed, and copies were distributed on November 24.

49305 **(DOE/IG—0210) Control and use of underrun funds at the Savannah River Operations Office.** 12 Oct 1984. 31p. H. File Number TI85001476.

Report to the Secretary.

This report describes the results of inspection of various line item projects at the Savannah River Operations Office. Inspection was generated by a complaint that these particular line items were overestimated and the resulting underrun funds were used to construct other projects that are loosely related, and sometimes unrelated, to the scope of work for which the funds had been appropriated. We found that the four waste management line item projects, listed in the complaint, which had a total estimated cost of $182 million were, indeed, overestimated. We found that a broad interpretation of the line item scopes of work was taken by management so as to use up the generated underrun funds on other projects. None of the additional projects were processed through reprogramming procedures. We also found that line item construction projects were kept open long after the original purpose of the projects had been achieved, so as to design and construct other projects with the leftover funds. Our review indicated that there are adequate policy and regulatory controls in place that provide for the control and use of underrun funds; it is the broad interpretation of the scopes of work that appears to be in conflict with the regulations.

49306 **(DOE/MA—0021/1) DOE property management regulations. Revisions effective June 21, 1984.** 14 Aug 1984. 166p. NTIS, PC A08/MF A01; GPO Dep. File Number DE85001361.

This is a revised issuance of subchapter A of the DOE property management regulations effective June 21, 1984. Topics covered include: defense materials, supply and procurement, ADP and telecommunications, transportation and motor vehicles, utilization and disposal, industrial plant equipment, and government property in the possession of off-site contractors.

49307 **(NSF—81-324) Research and development in industry, 1979: funds, 1979; scientists and engineers, January 1980.** (National Science Foundation, Washington, DC (USA)). Jan 1980. 96p. National Science Foundation, Washington, DC 20550. File Number TI84901906.

Statistical data are given for total funds for research and development, company funds for R and D, federal funds for R and D, funds by size of company, funds related to net sales, funds for research and funds for development, energy and pollution abatement R and D, the R and D distribution by special categories, geographic distribution of R and D funds, fund distribution by major type of cost, and employment.

49308 **(NUREG/CR—3750) Job analysis of nuclear power reactor health physics technicians.** Davis, L.T.; Mazour, T.J.; Clark, P.V.; Todd, R.C.; Marotta, F.J. (Analysis and Technology, Inc., North Stonington, CT (USA); Brookhaven National Lab., Upton, NY (USA)). Jun 1984. Contract AC02-76CH00016. 354p. (BNL-NUREG—51769). NTIS, PC A16/MF A01 - GPO. File Number TI84016298.

This report describes a project, an industry-wide Job Analysis of Nuclear Power Reactor Health Physics Technicians (HPTs), conducted by Brookhaven National Laboratory and Analysis & Technology, Inc. to provide the industry with job-performance data that can be used in systematically defining training programs in terms of required job functions responsibilities, and performance standards. The job-analysis methodology is consistent with that used by the Institute of Nuclear Power Operations (INPO) in similar industry-wide projects and includes administration of over 850 job task questionnaires to utility and contractor Health Physics Technicians throughout the country. Data collected includes task performance (difficulty, importance, and frequency) and industry-wide demographics (job levels, experience, education, and training). The results of this project discussed herein include model job descriptions for HPT positions, summaries of HPT experience, education, and training, industry-wide task listings with task-performance characteristics, and recommendations of selected tasks as a basis for HPT training development. Finally, potential future applications of the data base by utility and contractor organizations in training program development and evaluation and personnel qualifications are discussed.

49309 **(UCRL—52000-84-7) Energy and Technology Review, July 1984: state of the Laboratory.** (Lawrence Livermore National Lab., CA (USA)). 1984. Contract W-7405-ENG-48. 90p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85001472.

Each year, Director Roger Batzel addresses the LLNL staff on the state of the Laboratory and the achievements of the past year. On May 17, 1984, Dr. Batzel reported on the estimated budget for fiscal year 1985, which includes an 8.5% increase in operating funds, and on recent progress in our major programs. In this issue, we summarize Dr. Batzel's address and present a sampling of Laboratory achievements.

9902 Mathematics And Computers

REFER ALSO TO CITATION(S) 99020047341, 47356, 48688, 48689, 48690, 48777, 48913

49310 **(AD-A—141631/2) SREM (Software Requirements Engineering Methodology) evaluation. Volume 1. Final technical report 1 October 1980-15 November 1983.** Stone, A.; Hartschuh, D.; Castor, B. Feb 1984. 101p. (MCR—83-553-Vol.1). NTIS, PC A06/MF A01.

See also Volume 2, AD-A141632.

In the fall of 1980, the Rome Air Development Center contracted Martin Marietta Denver Aerospace to perform a comprehensive evaluation of the Software Requirements Engineering Methodology (SREM). The objectives of the evaluation were to assess the capabilities of SERM for specifying the software requirements of large, embedded computer systems and to recommend improvements which would enhance its effectiveness. Specific evaluation criteria were developed to judge the effectiveness of the methodology, support tools and user training. The approach included attending a SERM training course and using SERM to specify the software requirements for two Air Force systems. In general, it was found that the SERM was an effective vehicle for specifying and analyzing the software requirements of large embedded computer systems, especially descriptions of real world objects, data requirements and message processing. However, deficiencies were noted in the specification language, particularly in describing parallel and distributed processing requirements, in the friendliness of the user interfaces to the analysis (consistency/completeness) and simulation tools, in the performance of these tools and in the effectiveness of the training. Appropriate improvements to all of the functional deficiencies are recommended.

49311 **(AD-A—141632/0) SREM (Software Requirements Engineering Methodology) evaluation. Volume 2. Specifications and technical data. Final technical report 1 October 1980-15 November 1983.** Stone, A.; Hartschuh, D.; Castor, B. Feb 1984. 580p. (MCR—83-553-Vol.2). NTIS, PC A25/MF A01.

See also Volume 1, AD-A141631.

In the fall of 1980, the Rome Air Development Center contracted Martin Marietta Denver Aerospace to perform a comprehensive evaluation of the Software Requirements Engineering Methodology (SREM). The objectives of the evaluation were to assess the capabilities of SERM for specifying the software requirements of large, embedded computer systems and to recommend improvements which would enhance its effectiveness. Specific evaluation criteria were developed to judge the effectiveness of the methodology, support tools and user training. The approach included attending a SERM training course and using SERM to specify the software requirements for two Air Force systems. In general, it was found that the SERM was an effective vehicle for specifying and analyzing the software requirements of large embedded computer systems, especially descriptions of real work objects, data requirements and message processing. However, deficiencies were noted in the specification language, particularly in describing parallel and distributed processing requirements, in the friendliness of the user interfaces to the analysis (consistency/completeness) and simulation tools, in the performance of these tools and in the effectiveness of the training. Appropriate improvements to all of the functional deficiencies are recommended.

49312 **(AD-A—142414/2) A minimum area VLSI (very large scale integrated architecture for o(logn) time sorting. Technical report.** Bilardi, G.; Preparata, F.P. Nov 1983. 28p. (UILU-ENG—83-2227). NTIS, PC A03/MF A01.

Also available as Rept. No. R-1006.

A generalization of a known class of parallel sorting algorithms is presented, together with a new architecture to execute them. A VLSI implementation is also proposed, and its area-time performance is discussed. It is shown that an algorithm in the class is executable in 0(logn) time by a chip occupying O(n2) area. The design is a typical instance of a 'hybrid architecture', resulting from the combination of well-known VLSI arrays as the orthogonal-trees and the cube-connected-cycles; it is also the first known to meet the

AT21 = omega(n2log2n) lower bound for sorters of n words of length (1 + epsilon) and working in minimum 0(logn) time.

49313 **(AD-A—142482/9) Design issues in parallel architectures for artificial intelligence. Memorandum report.** Hewitt, C.; Lieberman, H. Nov 1983. 17p. NTIS, PC A02/MF A01.

Development of highly intelligent computers requires a conceptual foundation that will overcome the limitations of the von Neumann architecture. Architectures for such a foundation should meet the following design goals: Address the fundamental organizational issues of large-scale parallelism and sharing in a fully integrated way. This means attention to organizational principles, as well as hardware and software. Serve as an experimental apparatus for testing large-scale artificial intelligence systems. Explore the feasibility of an architecture based on abstractions, which serve as natural computational primitives for parallel processing. Such abstractions should be logically independent of their software and hardware host implementations. In this paper we lay out some of the fundamental design issues in parallel architecture for Artificial Intelligence, delineate limitations of previous parallel architectures, and outline a new approach that we are pursuing.

49314 **(AD-A—142712/9) Inductive information retrieval using parallel distributed computation. Technical report.** Mozer, M.C. Jun 1984. 27p. NTIS, PC A03/MF A01.

Massively parallel, distributed models of computation offer a new approach to the representation and manipulation of knowledge. This paper reports on an application of parallel models to the area of information retrieval. The retrieval system described makes dynamic use of the internal structure of a database to infer relationships among items in the database. Using these relationships, the system can help overcome incompleteness and imprecision in requests for information, as well as in the database itself.

49315 **(EPRI-EL—3089-SY) Software development and maintenance guidelines. Executive summary.** Downs, H.R. (Science Applications, Inc., Palo Alto, CA (USA)). Aug 1984. 19p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920033.

This report is an Executive Summary to a set of guidelines for the development and maintenance of software. This document describes the basis for the guidelines, provides a primer on computing concepts, discusses the software life cycle, and suggests the use of automatic diagnostic and analytical tools. The guidelines are intended for use by persons producing or managing the production of software for the electric power industry.

49316 **(EPRI-EL—3089-Vol.3) Software development and maintenance guidelines. Volume 3. General summary.** Downs, H.R. (Science Applications, Inc., Palo Alto, CA (USA)). Aug 1984. 291p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920030.

This report is a General Summary of the Software Development and Maintenance Guidelines. The Guidelines are intended for use by persons producing or managing the production of software for the Electric Power Industry. The Guidelines will lead to better quality software, whose life cycle cost will be substantially less than software produced without such guidelines. It is recognized that the use of these Guidelines may result in increased development cost; however, any such increases are offset by factors of two to ten in maintenance costs during the software life cycle. The General Summary is intended to be used by software developers and anyone else as a reference to the Guidelines. The General summary provides a summary of the contents of the Guidelines but without all the details of the full Guidelines. The General Summary provides a convenient source for frequent reference to the Guidelines. Although the Guidelines do not require the use of any specific development methodology, they do specify that an organized, systematic methodology employing a phased approach shall be used. These Guidelines provide overall procedural and documentation guidelines, as well as guidelines for each stage in the software life cycle process.

49317 **(GRS-A—588) STREUSL - a computer code for determining the variance of availability parameters as a function of input parameter variance.** Zipf, G. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Garching (Germany, F.R.)). Apr 1981. 117p. (In German). Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Garching (Germany, F.R.).

This report describes the computer code STREUSL, which calculates the influence of the variance of the input parameters on the average unavailability and failure frequency of complex systems. Besides an introduction to the theoretical background of this program, there is a detailed description of the programming techniques, the structure, the input and output of the program. So this report enables the user to implement and to handle the program STREUSL.

49318 **(PB—84-214253) Formalism for the design and evaluation of parallel signal processing systems.** Kronloef, K. 6 Apr 1984. 165p. (TKK-F-A—548). NTIS, PC E08/MF E01.

The methodology presented in this thesis is based on graphical models for computing algorithms and computer architectures. The formalism is particularly adaptable to the development of special purpose architectures for Digital Signal Processing (DSP) algorithms. It also supports the utilization of Very Large-Scale Integrated (VLSI) circuits for the implementation. The verification of functional correctness is emphasized. The dependence model (DPM) is used for algorithms. It has a permissive execution rule, uses the stream data type, and defines all data and control dependences graphically. These features enable it to represent parallelism, continuous computations, and functional sequencing constraints, respectively. Architectures are modelled with the processor network model (PNM). Its structural, functional, and physical parts specify the topological, behavioral, and metric properties of the architecture, respectively. The modelling scheme is capable of specifying the design constraints of custom VLSI. Unlike the systolic VLSI models, the PNM has an asynchronous mode of operation in order to support self-timed design methodologies.

49319 **(SAND—84-1410) Fixed vs variable order Runge-Kutta.** Shampine, L.F.; Baca, L.S. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1984. Contract AC04-76DP00789. 62p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85001320.

Popular codes for the numerical solution of non-stiff ordinary differential equations (ODEs) are based on a (fixed order) Runge-Kutta method, a variable order Adams method, or an extrapolation method. Extrapolation can be viewed as a variable order Runge-Kutta method. It is plausible that variation of order could lead to a much more efficient Runge-Kutta code, but numerical comparisons have been contradictory. We reconcile previous comparisons by exposing differences in testing methodology and incompatibilities of the implementations tested. An experimental Runge-Kutta code is compared to a state-of-the-art extrapolation code. With some qualifications, the extrapolation code shows no advantage. Extrapolation does not appear to be a particularly effective way to vary the order of Runge-Kutta methods. Although a good way to solve non-stiff problems, our tests raise the question as to whether there is any point to pursuing it as a separate method. 30 references, 15 figures.

49320 **(UCID—20167) Multitasking kernel for the C and Fortran programming languages.** Brooks, E.D. III. (Lawrence Livermore National Lab., CA (USA)). Sep 1984. Contract W-7405-ENG-48. 19p. NTIS, PC A02/MF A01. File Number DE85001799.

A multitasking kernel for the C and Fortran programming languages which runs on the Unix operating system is presented. The kernel provides a multitasking environment which serves two purposes. The first is to provide an efficient portable environment for the coding, debugging and execution of production multiprocessor programs. The second is to provide a means of evaluating the performance of a multitasking program on model multiprocessors. The performance evaluation features require no changes in the source code of the application and are implemented as a set of compile and run time options in the kernel.

49321 (UCID—20169) **Code ALICE/85/300.** Blann, M. (Lawrence Livermore National Lab., CA (USA)). Sep 1984. Contract W-7405-ENG-48. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85001800.

A modified version of the precompound plus compound nucleus decay code ALICE/LIVERMORE 82 is described. A listing and sample input/output are included. The changes from the earlier version are described. Additional special versions of the code are described and listings of relevant routines of several of these are included in this report.

49322 (UCID—30203) **TRIDAC host computer functional specification.** Hilbert, S.M.; Hunter, S.L. (Lawrence Livermore National Lab., CA (USA)). 23 Aug 1983. Contract W-7405-ENG-48. 97p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85001765.

The purpose of this document is to outline the baseline functional requirements for the Triton Data Acquisition and Control (TRIDAC) Host Computer Subsystem. The requirements presented in this document are based upon systems that currently support both the SIS and the Uranium Separator Technology Groups in the AVLIS Program at the Lawrence Livermore National Laboratory and upon the specific demands associated with the extended safe operation of the SIS Triton Facility.

9903 Information Handling

49323 (DOE/TIC/EGC—84/2) **Energygrams: brief descriptions of energy technology.** Simpson, W.F. Jr. (ed.). (USDOE Technical Information Center, Oak Ridge, TN). 1984. 71p. (PB—84-903602). NTIS $8.00 single copy (subscription item). File Number TI84013097.

The Technical Information Center routinely screens all DOE R and D reports to identify appropriate information. It also coordinates with DOE and DOE laboratory and contractor program managers in identifying research and development projects for the transfer program and in reviewing the technical content of Energygrams before publication. Energygrams are usually one-page illustrated bulletins describing DOE technology or data and telling how to obtain the technical reports, patent documents, software or other material on which they are based. The compilation is organized by subject categories, and within each category, Energygrams are presented alphabetically by Energygram title. The Subject Index is cumulated with each issue by calendar year.

49324 (NUREG/CR—3951) **Introduction to BIBELOT: a bibliographic filing and retrieval system.** Cochran, M.I. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1984. Contract AC06-76RL01830. 40p. (PNL—5202). NTIS, PC A03/MF A01 - GPO $3.75. File Number TI85002084.

The BIBELOT System of COBOL and Datatrieve programs for bibliographic storage and retrieval is described. The storage scheme is also briefly described. The use of unique citation numbers and user defined keywords is illustrated by many retrieval examples. Finally, typical questions about the use of BIBELOT are answered.

49325 (UCID—30204) **Information model for experiment systems.** Hilbert, S.M. (Lawrence Livermore National Lab., CA (USA)). 14 Feb 1983. Contract W-7405-ENG-48. 244p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE85001586.

The purpose of this document is to specify the requirements for a data base that will support Experiment Systems in the LIS Program. This information model is a conceptual model for that data base. It reflects the information that is needed to describe an experiment, the data, the parameters, and the data acquisition and control environment. The model gives meaning to the information that will be resident in the data base, it does NOT specify the physical representation NOR the means of implementation.

9904 Law

49326 (INIS-mf—9062) **Summary of the law relating to atomic energy and radioactive substances.** Sim, D.F.; Ritchie, K.J.S. (UKAEA Headquarters, London). 31 Mar 1983. 21p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84780619.

This summary is an updated version of a previous revision of the summary of the United Kingdom's legislation on atomic energy and reviews the main texts in that field. Reference is made to the regulations on atomic energy, nuclear installations, radioactive substances, transport of such substances, radiation protection etc. The Energy Act 1983 amends the third party liability provisions of the nuclear installations Act 1965 in particular by raising the limits of compensation for nuclear damage.

9905 Civilian Defense

49327 (INIS-mf—8836) **Civil Defense Commission of the Federal Minister of the Interior. Conference papers.** (Bundesministerium des Innern, Bonn (Germany, F.R.). Schutzkommission; Bundesamt fuer Zivilschutz, Bonn (Germany, F.R.)). 1982. 237p. (CONF-8205271—). NTIS (US Sales Only), PC A11/MF A01. File Number DE84780575.

From 31. annual meeting of the Civil Defense Commission of the Federal Minister of the Interior; Trier, F.R. Germany (1 May 1982).

Items within the scope of EDB have been entered individually into the data base.

CORPORATE AUTHOR INDEX

In the Corporate Index, report literature is indexed using the name of the organization or institution responsible for issuing the report. Headings are provided for all report literature and for published literature for which a corporate approach is especially desirable, e.g., symposium and conference proceedings.

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The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processes applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept. (e.g. Pipeline Quality Gas see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed. Copies of DOE/TIC-7000, the Subject Thesaurus, are available from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, VA 22161.

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	Chem-Pro Corp., Fairfield, NJ (USA)	
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AC05-84OR21400	**Oak Ridge National Lab., TN (USA)**	
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	Varian Associates, Inc., Palo Alto, CA (USA)	
	9:48905	ORNL/Sub—79-21453/17
AC05-84OS21400	**Oak Ridge Y-12 Plant, TN (USA)**	
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AC05-84OT21400	**Oak Ridge Gaseous Diffusion Plant, TN (USA)**	
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AC06-76RL01830	**Pacific Northwest Lab., Richland, WA (USA)**	
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	Pacific Northwest Lab., Richland, WA (USA)	
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	Pacific Northwest Lab., Richland, WA (USA)	
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	9:48576	BMI/ONWI—544
	Battelle Columbus Labs., OH (USA)	
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	Colorado School of Mines, Golden (USA)	
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AC06-76RL01857	**UNC Nuclear Industries, Inc., Richland, WA (USA)**	
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AC07-76ID01570	**EG and G Idaho, Inc., Idaho Falls (USA)**	
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	Idaho National Engineering Lab., Idaho Falls (USA)	
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AC07-83ID12379	**Membrane Technology and Research, Inc., Menlo Park, CA (USA)**	
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AC07-84ID12435	**Westinghouse Idaho Nuclear Co., Inc., Idaho Falls (USA)**	
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AC08-80DP40124	**Univ. of Rochester, NY**	
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AC09-76SR00819	**Savannah River Ecology Lab., Aiken, SC (USA)**	
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AC19-80BC10327	**Scientific Software Corp., Denver, CO (USA)**	
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AC21-83MC20110	**Acurex Corp., Mountain View, CA (USA). Energy and Environmental Div.**	
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AC22-76ET10154	**Catalytic, Inc., Wilsonville, AL (USA)**	
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AC22-76ET10532	**Chevron Research Co., Richmond, CA (USA)**	
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AC22-80ET15614	**Avco Everett Research Lab., Everett, MA**	
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AC22-82PC50046	**Pittsburg and Midway Coal Mining Co., Denver, CO (USA)**	
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AC22-83PC60019	**Mobil Research and Development Corp., Paulsboro, NJ (USA)**	
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AC22-83PC60048	**Kerr-McGee Corp., Oklahoma City, OK (USA). Project Engineering Dept.**	
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AC22-83PC60265	**Science Applications International Corp., San Diego, CA (USA)**	
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AC22-83PC62999	**Cincinnati Univ., OH (USA). Dept. of Environmental Health**	
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AC22-84PC70508	**TRW Energy Development Group, Redondo Beach, CA (USA)**	
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AI01-76ET20356	**Jet Propulsion Lab., Pasadena, CA (USA)**	
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AI01-78CS54209	**General Electric Co., Schenectady, NY (USA). Corporate Research and Development Dept.**	
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6939	NTIS (US Sales Only), PC A04/MF A01; 1	DE85900042	MN -25	9:48163
AFIT/GNE/PH-				
84M-9	*See* AD-A-141402/8			9:48422
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157	*See* AD-A-141701/3			9:47443
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254	NTIS, PC A02/MF A01 (GPO Dep.)	DE84017337	MN -4	9:48299
ANL/AA-				
29	*See* NUREG/CR-3929	TI84017274	MN -80	9:47989
ANL/CNSV-TM-				
143	NTIS, PC A03/MF A01 (GPO Dep.)	DE85001475	MN -98	9:47433
ANL/EES-TM-				
255	NTIS, PC A11/MF A01 (GPO Dep.)	DE85001769	MN -80	9:47953
ANL-HEP-CP-				
84-54	NTIS, PC A02/MF A01 (GPO Dep.)	DE84016317	MN -34D	9:48656
84-61	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84017486	MN -25	9:48367
APAE-				
2687-5	NTIS, PC A03/MF A01 (GPO Dep.)	DE84017609	MN -13	9:47411
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83044	*See* AD-A-141447/3			9:48221
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26	Nederlands Energy Research Foundation, Petten			9:47352
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546	*See* PB-84-202274			9:47538
560	*See* PB-84-203306			9:47539
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8968	*See* PB-84-199710			9:48451
8971	*See* PB-84-189463			9:47389
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8852	*See* PB-84-189562			9:47362
8857	*See* PB-84-199298			9:48099
8870	*See* PB-84-213883			9:47324
BMI/OCRD-				
4(4)	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85001802	STD -70	9:48604
12	NTIS, PC A03/MF A01 (GPO Dep.)	DE85001949	STD -70	9:47487
BMI/ONWI-				
19(FY-84)	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE85001801	STD -70	9:47488
544	NTIS, PC A05/MF A01 (GPO Dep.)	DE85000384	STD -70	9:48576
BNL-				
34934	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85001348	MN -28	9:48377
35057	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85001346	MN -90d	9:47412
35060	NTIS, PC A02/MF A01 (GPO Dep.)	DE84015725	MN -34	9:48657
35082	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84016439	MN -34D	9:48686
35086	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84016435	MN -34D	9:48658
35087	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84016445	MN -34D	9:48659
35100	NTIS, PC A02/MF A01 (GPO Dep.)	DE85001354	MN -34	9:48632
35104	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84016433	MN -34C	9:48164
35106	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84016990	MN -34D	9:48660
35109	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84016441	MN -34	9:48765
35110	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84016431	MN -4	9:48227
35121	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85001942	MN -28	9:48372
35154	NTIS, PC A02/MF A01 (GPO Dep.)	DE85001352	MN -34D	9:48759
35167	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85001353	MN -34D	9:48754
35170	NTIS, PC A02/MF A01 (GPO Dep.)	DE84016988	MN -34D	9:48661
35181	NTIS, PC A02/MF A01 (GPO Dep.)	DE85001359	MN -34D	9:48766
51693	NTIS, PC A04/MF A01 (GPO Dep.)	DE84017196	STD -59a	9:47645
51730	NTIS, PC A17/MF A01; 1 (GPO Dep.)	DE84017247	STD -48	9:48529
51748	NTIS, PC A14/MF A01; 1 (GPO Dep.)	DE84017244	STD -95	9:48013
51753	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84017184	STD -97a	9:47760
51765	NTIS, PC A05/MF A01 (GPO Dep.)	DE84017181	STD -95d	9:48017
51799	NTIS, PC A04/MF A01 (GPO Dep.)	DE84017481	STD -90d	9:47577

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BNL-NCS-				
51572-Add.	NTIS, PC A02/MF A01 (GPO Dep.)	DE85002134	STD -34C	9:48728
BNL-NUREG-				
27773	NTIS, PC A05/MF A01 - GPO	TI84017347	MN -70	9:47489
29860	NTIS, PC A02/MF A01 - GPO	TI84017654	MN -80	9:47835
34701	NTIS, PC A02/MF A01 - GPO (GPO Dep.)	TI84012909	MN -78	9:47836
34896	NTIS, PC A02/MF A01 - GPO (GPO Dep.)	TI84014387	MN -70B	9:47490
34897	NTIS, PC A02/MF A01 - GPO (GPO Dep.)	TI84014348	MN -70	9:47491
51297	*See* NUREG/CR-1799	TI84017650	MN -80	9:47863
51399	*See* NUREG/CR-2159	TI84017627	MN -78	9:47865
51454-Vol.3-No.4	*See* NUREG/CR-2331-Vol.3-No.4	TI84016812	MN -80	9:47867
51650	*See* NUREG/CR-3169	TI84017268	MN -79	9:47868
51708-Vol.1	*See* NUREG/CR-3469-Vol.1	TI84017271	MN -41	9:47872
51767	*See* NUREG/CR-3766	DE84014580	MN -80	9:47821
51769	*See* NUREG/CR-3750	TI84016298	MN -2	9:49308
51774	*See* NUREG/CR-3812	TI84016420	MN -70	9:47534
51793	*See* NUREG/CR-3868	TI84016810	MN -77	9:47880
BNWL-CC-				
900	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84017370	MN -38	9:48351
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757	*See* AD-A-141813/6			9:47594
CE-Trans-				
7988	NTIS (US Sales Only), PC A03/MF A01; 1	DE84901730	MN -61C	9:48306
8009	NTIS (US Sales Only), PC A02/MF A01; 1	DE84901821	MN -90a	9:47330
CEA-CONF-				
6824	NTIS (US Sales Only), PC A03/MF A01	DE84751745	MN -80	9:47827
7100	NTIS (US Sales Only), PC A02/MF A01	DE84751756	MN -48	9:48530
7103	NTIS (US Sales Only), PC A02/MF A01	DE84751758	MN -48	9:48531
7104	NTIS (US Sales Only), PC A02/MF A01	DE84751757	MN -48	9:48532
7111	NTIS (US Sales Only), PC A02/MF A01	DE84751747	MN -34C	9:48731
7122	NTIS (US Sales Only), PC A02/MF A01	DE84751746	MN -34C	9:48732
7156	NTIS (US Sales Only), PC A02/MF A01	DE84751752	MN -79	9:47794
7157	NTIS (US Sales Only), PC A04/MF A01	DE84751751	MN -80	9:47795
7158	NTIS (US Sales Only), PC A02/MF A01	DE84751750	MN -28	9:48388
7166	NTIS (US Sales Only), PC A02/MF A01	DE84751759	MN -78	9:47777
CERL-TR-E-				
192	*See* AD-A-141839/1			9:47627
194	*See* AD-A-142678/2			9:47628
CETEM-CT-				
36	Centro de Tecnologia Mineral (CETEM), Rio de Janerio, Brazil			9:47405
CLM-CD-				
1983(Vol.2)	NTIS (US Sales Only), PC A12/MF A01	DE84780558	MN -20	9:48830
CNEA-				
406	NTIS (US Sales Only), PC A02/MF A01; 1	DE84901964	MN -48	9:48533
CONF-680444-	(Symposium on skeletal mineralization, Detroit, MI, USA, 24 Apr 1968)			
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84017611	MN -48	9:48561
CONF-7710198-	(17. international conference of mining safety research, Varna, Bulgaria, 3-7 Oct 1977)			
1-Trans.	*See* SMRE-Trans-7276-T	DE84901844	MN -90i	9:47404
CONF-8110316-	(La Mesa fire symposium, Los Alamos, NM, USA, 6-7 Oct 1981)			
	See LA-9236-NERP	DE84010095	STD -11	9:48486
CONF-811103-	(ANS winter meeting, San Francisco, CA, USA, 29 Nov-4 Dec 1981)			
28	*See* BNL-NUREG-29860	TI84017654	MN -80	9:47835
CONF-8205270-	(12. All-Union conference on physics of interaction between charged particles and crystals, Moscow, USSR, 25-27 May 1982)			
	See INIS-SU-247	DE84780555	MN -34A	9:48174
CONF-8205271-	(31. annual meeting of the Civil Defense Commission of the Federal Minister of the Interior, Trier, F.R. Germany, 1 May 1982)			
	See INIS-mf-8836	DE84780575	MN -48	9:49327
CONF-8208201-	(Symposium on the Department of Energy's intermediate future forecasting system, Washington, DC, USA, 19 Aug 1982)			
	See NBS-SP-670	DE84017607	MN -98	9:47914
CONF-820933-	(International conference on radioactive waste management, Winnipeg, Manitoba, Canada, 12-15 Sep 1982)			
Summs.	*See* INIS-mf-9040	DE84780568	MN -4	9:47530
CONF-8209249-	(International conference on flow induced vibrations in fluid engineering, Reading, UK, 1 Sep 1982)			
	J. Sound Vib., 93: No. 3, 439-455(8 Apr 1984)			9:48345
CONF-821015-	(Electrochemical Society fall meeting, Detroit, MI, USA, 17-22 Oct 1982)			
	J. Electrochem. Soc., 130: 1646-1650(Aug 1983)			9:47912
CONF-821184-	(4. parabolic dish solar thermal power program review meeting, Pasadena, CA, USA, 30 Nov-2 Dec 1982)			
	See DOE/JPL-1060-58	DE83011247	STD -62b	9:47614

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CONF-830316-	(Distributed solar collector conference, Albuquerque, NM, USA, 15-17 Mar 1983)			
	See SAND-83-0137C	DE83010276	STD -59c	9:47638
CONF-830365-	(Seminar on energy efficiency and conservation, Lome, Togo, Africa, 30 Mar-8 Apr 1983)			
	See BNL-51748	DE84017244	STD -95	9:48013
CONF-830452-	(Technical meeting on non-inductive current drive in tokamaks, Abingdon, UK, 18-21 Apr 1983)			
Vol.2	*See* CLM-CD-1983(Vol.2)	DE84780558	MN -20	9:48830
CONF-830455-	(Yamada conference on muon spin rotation and associated problems, Shimoda, Japan, 18-27 Apr 1983)			
	Hyperfine Interact., 17: No. 1-4, 351-354(Jan 1984)			9:48189
	Hyperfine Interact., 18: No. 1-4, 447-451(Jan 1984)			9:48190
	Hyperfine Interact., 18: No. 1-4, 457-461(Jan 1984)			9:48191
	Hyperfine Interact., 18: No. 1-4, 463-466(Jan 1984)			9:48192
	Hyperfine Interact., 18: No. 1-4, 467-471(Jan 1984)			9:48193
	Hyperfine Interact., 18: No. 1-4, 509-514(Jan 1984)			9:48215
	Hyperfine Interact., 18: No. 1-4, 575-579(Jan 1984)			9:48243
	Hyperfine Interact., 17: No. 1-4, 355-357(Jan 1984)			9:48649
	Hyperfine Interact., 18: No. 1-4, 615-617(Jan 1984)			9:48650
CONF-8304105-	(6. international tandem conference, Chester, UK, 16-23 Apr 1983)			
	Nucl. Instrum. Methods Phys. Res., Sect. A, 220: No. 1, 209-210(15 Feb 1984)			9:48371
	Nucl. Instrum. Methods Phys. Res., Sect. A, 220: No. 1, 1-9(15 Feb 1984)			9:48384
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	Nucl. Instrum. Methods Phys. Res., Sect. A, 220: No. 1, 107-108(15 Feb 1984)			9:48386
	Nucl. Instrum. Methods Phys. Res., Sect. A, 220: No. 1, 118-122(15 Feb 1984)			9:48387
CONF-8304125-	(DOE solar central receiver annual meeting, Albuquerque, NM, USA, 26-27 Apr 1983)			
	See SAND-83-8018	DE84000929	STD -62c	9:47617
CONF-8304181-	(Seminar on fast scintillation phosphors, Bruyeres-la-Chatel, France, 19 Apr 1983)			
1	*See* CEA-CONF-7100	DE84751756	MN -48	9:48530
CONF-8304182-	(2. international symposium on the basis of new techniques in medicine, Liege, Belgium, 15-16 Apr 1983)			
1	*See* CEA-CONF-7104	DE84751757	MN -48	9:48532
2	*See* CEA-CONF-7103	DE84751758	MN -48	9:48531
CONF-8304191-	(International school of nuclear physics, Erice, Italy, 6-18 Apr 1983)			
	Prog. Part. Nucl. Phys., 11: 505-528(1984)			9:48751
CONF-8305156-	(16. informal meeting on reactor noise, Budapest, Hungary, 18-20 May 1983)			
2	*See* CEA-CONF-7156	DE84751752	MN -79	9:47794
CONF-8305160-	(Seismic risk and heavy industrial facilities conference, San Francisco, CA, USA, 11-13 May 1983)			
Summs.	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE84004249	MN -11	9:47841
CONF-830640-	(ASHRAE conference, Washington, DC, USA, 26-30 Jun 1983)			
	ASHRAE Trans., 89: 3-28(Jun 1983)			9:48036
	ASHRAE Trans., 89: 61-77(Jun 1983)			9:48037
	ASHRAE Trans., 89: 391-406(Jun 1983)			9:48038
	ASHRAE Trans., US: 416-440(Jun 1983)			9:48039
	ASHRAE Trans., 89: 755-769(Jun 1983)			9:48040
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	ASHRAE Trans., 89: 157-182(Jun 1983)			9:48042
	ASHRAE Trans., 89: 183-200(Jun 1983)			9:48043
	ASHRAE Trans., 89: 407-415(Jun 1983)			9:48044
	ASHRAE Trans., 89: 507-532(Jun 1983)			9:48045
	ASHRAE Trans., 89: 782-796(Jun 1983)			9:48046
	ASHRAE Trans., 89: 480-495(Jun 1983)			9:48047
CONF-830664-	(International gas research conference, London, UK, 13-16 Jun 1983)			
6-Trans.	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84017116	MN -90c	9:47302
CONF-8306126-	(American Society of Agricultural Engineers summer meeting, Bozeman, MT, USA, 26-29 Jun 1983)			
1	NTIS, PC A02/MF A01; 1	DE85900079	MN -88	9:47353
2	NTIS, PC A02/MF A01	DE85900080	MN -88	9:47354
3	NTIS, PC A02/MF A01; 1	DE85900081	MN -88	9:47380
4	NTIS, PC A02/MF A01	DE85900082	MN -88	9:47331
5	NTIS, PC A02/MF A01; 1	DE85900088	MN -88	9:47355
6	NTIS, PC A02/MF A01; 1	DE85900083	MN -88	9:47356
7	NTIS, PC A02/MF A01	DE85900091	MN -92	9:47440
8	NTIS, PC A02/MF A01; 1	DE85900092	MN -88	9:47357
9	NTIS, PC A02/MF A01	DE85900090	MN -88	9:47358
10	NTIS, PC A02/MF A01; 1	DE85900089	MN -88	9:47359
11	NTIS, PC A02/MF A01; 1	DE85900093	MN -88	9:47360

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CONF-8306206-	(NEA specialist meeting on the intercomparison of calculations for the pin-plate cell heterogeneity benchmark, Winfrith, UK, 21-23 Jun 1983)			
1	*See* CEA-CONF-7157	DE84751751	MN -80	9:47795
CONF-8308132-	(NATO/CAP institute on moment formation in solids, Vancouver Island, Canada, 21 Aug-2 Sep 1983)			
3	NTIS, PC A02/MF A01 (GPO Dep.)	DE84017480	MN -4	9:48168
CONF-8308170-	(Meeting on medical physics in Rio de Janeiro, Rio de Janeiro, Brazil, 25-26 Aug 1983)			
	See INIS-BR-121	DE84780533	MN -41	9:48790
CONF-830980-	(Passive and hybrid solar energy program update conference, Washington, DC, USA, 26-28 Sep 1983)			
	NTIS, PC A13/MF A01; 1	DE84003039	MN -59c	9:47629
CONF-8309118-	(Topical meeting on free electron generation of extreme ultraviolet coherent radiation, Upton, NY, USA, 19-22 Sep 1983)			
11	*See* CEA-CONF-7158	DE84751750	MN -28	9:48388
CONF-8309186-	(49. meeting of the French working group on dosimetry, Grenoble, France, 21-22 Sep 1983)			
5	*See* CEA-CONF-6824	DE84751745	MN -80	9:47827
CONF-8309259-	(Workshop seminar on finite element multidimensional diffusion codes, Saclay, France, 15-16 Sep 1983)			
	Newsl. NEA Data Bank, No. 30, 287-304(Dec 1983)			9:47816
CONF-8309272-	(International symposium on aquatic macrophytes, Nijmegen, Netherlands, 18-23 Sep 1983)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84016016	MN -11	9:48527
CONF-831086-	(Electrochemical Society fall meeting, Washington, DC, USA, 9-14 Oct 1983)			
	Proc. - Electrochem. Soc., 84-4: 134-142(Oct 1983)			9:47906
	Proc. - Electrochem. Soc., 84-4: 187-197(Oct 1983)			9:47907
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	Proc. - Electrochem. Soc., 84-4: 95-108(Oct 1983)			9:47909
	Proc. - Electrochem. Soc., 84-4: 64-74(Oct 1983)			9:47910
	Proc. - Electrochem. Soc., 84-4: 53-63(Oct 1983)			9:47911
CONF-8310177-	(2. annual DOE geothermal progress review meeting, Washington, DC, USA, 11-12 Oct 1983)			
	NTIS, PC A19/MF A01; 1 (GPO Dep.)	DE84005062	STD -66	9:47652
CONF-8310235-	(IAEA specialists' meeting on pellet-cladding interaction in water reactor fuel, Seattle, WA, USA, 3-5 Oct 1983)			
	See IWGFPT-18	DE84901766	MN -78	9:47775
CONF-8310253-	(Symposium on neutron capture therapy, Boston, MA, USA, 12-14 Oct 1983)			
	See BNL-51730	DE84017247	STD -48	9:48529
CONF-8310269-	(French-Japanese colloquium on comparison between hadronic and nuclear research at intermediate energies, Dogashima, Japan, 3-7 Oct 1983)			
4	*See* CEA-CONF-7122	DE84751746	MN -34C	9:48732
5	*See* CEA-CONF-7111	DE84751747	MN -34C	9:48731
CONF-831111-	(ASME winter annual meeting, Boston, MA, USA, 13-18 Nov 1983)			
	Am. Soc. Mech. Eng., [Pap.], 83-WA/SOL-9: 6(Nov 1983)			9:47623
	Am. Soc. Mech. Eng., [Pap.], 83-WA/SOL-7: 6(Nov 1983)			9:47642
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	Am. Soc. Mech. Eng., [Pap.], 83-WA/SOL-14: 8(Nov 1983)			9:47648
	Am. Soc. Mech. Eng., [Pap.], 83-WA/SOL-1: 11(Nov 1983)			9:47649
	Am. Soc. Mech. Eng., [Pap.], 83-WA/HT-31: 7(Nov 1983)			9:48346
CONF-831115-	(6. world energy engineering congress, Atlanta, GA, USA, 29 Nov-1 Dec 1983)			
	Atlanta, GA, USA; Fairmont Press (1983).			9:48082
	Atlanta, GA, USA; Fairmont Press (1983).			9:48126
CONF-831142-	(Automotive technology development contractor coordination meeting, Dearborn, MI, USA, 13-17 Nov 1983)			
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85001552	MN -25	9:48204
CONF-831175-	(6. international conference on nondestructive evaluation in the nuclear industry, Zurich, Switzerland, 27 Nov-2 Dec 1983)			
9	*See* CEA-CONF-7166	DE84751759	MN -78	9:47777
CONF-831203-	(10. symposium on fusion engineering, Philadelphia, PA, USA, 5-9 Dec 1983)			
173	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85000951	MN -20b	9:48892
181	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85000954	MN -20	9:48893
182	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85000956	MN -20b	9:48894

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CONF-831205-	(6. Miami international conference on alternative energy sources, Miami Beach, FL, USA, 12-14 Dec 1983)			
	Alternative Energy Sources, 109-110(Dec 1983)			9:48033
	Alternative Energy Sources, 103(Dec 1983)			9:48034
CONF-831287-	(EPRI PCB seminar, Atlanta, GA, USA, 6-8 Dec 1983)			
	See EPRI-EL-3581	TI84920501	ND -97	9:47925
CONF-831290-	(Design of flat-plate photovoltaic arrays for central stations research forum, Sacramento, CA, USA, 5-8 Dec 1983)			
	See DOE/JPL-1012-98	DE85000332	STD -63b	9:47607
CONF-840145-	(INDO-US workshop on diffusion in solids, Bombay, India, 9-13 Jan 1984)			
4	NTIS, PC A02/MF A01 (GPO Dep.)	DE85000984	MN -25	9:48228
CONF-840201-	(ASME energy sources technology conference and exhibition, New Orleans, LA, USA, 12-16 Feb 1984)			
	Am. Soc. Mech. Eng., [Pap.], 84-AES-12: 6(Feb 1984)			9:47896
	Am. Soc. Mech. Eng., [Pap.], 84-PET-28: 8(Feb 1984)			9:48330
CONF-840275-	(Workshop on anti pp options for the SSC, Chicago, IL, USA, 13-17 Feb 1984)			
12	*See* ANL-HEP-CP-84-54	DE84016317	MN -34D	9:48656
CONF-840295-	(ANS/ENS topical meeting on probabilistic safety methods and applications, San Francisco, CA, USA, 24-28 Feb 1984)			
2-Summ.	*See* UCRL-91463	DE84017022	MN -80	9:47885
CONF-8402105-	(Acid rain: an intergovernmental policy forum, Albany, NY, USA, 7-8 Feb 1984)			
Summ.	New York State Senate, Albany, NY 12247	TI85900026	MN -11	9:47924
CONF-840311-	(4. international symposium on heating in toroidal plasmas, Rome, Italy, 21-28 Mar 1984)			
15	*See* PPPL-2114	DE84017066	STD -20a	9:48840
CONF-840383-	(12. symposium on explosives and pyrotechnics, San Diego, CA, USA, 13-15 Mar 1984)			
4	*See* SAND-83-1892C	DE84017255	MN -45	9:48419
5	*See* SAND-83-1894C	DE84017254	MN -45	9:48420
CONF-8403112-	(International symposium on nuclear spectroscopy and nuclear interactions, Osaka, Japan, 21-24 Mar 1984)			
6	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85001101	MN -34D	9:48761
CONF-8403113-	(Europhysics conference, Erice, Italy, 4-11 Mar 1984)			
2	*See* LBL-17899	DE84014589	MN -34D	9:48668
3	*See* BNL-35060	DE84015725	MN -34	9:48657
4	*See* BNL-35087	DE84016445	MN -34D	9:48659
5	*See* BNL-35086	DE84016435	MN -34D	9:48658
6	*See* BNL-35170	DE84016988	MN -34D	9:48661
CONF-8403137-	(Workshop on detectors for relativistic nuclear collisions, Berkeley, CA, USA, 26-30 Mar 1984)			
2	*See* BNL-35106	DE84016990	MN -34D	9:48660
CONF-8403138-	(Workshop on electricity demand forecasting residential sector models, Washington, DC, USA, 16 Mar 1984)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84014728	MN -97c	9:47993
CONF-840417-	(High-temperature alloys - theory and design conference, Bethesda, MD, USA, 8-12 Apr 1984)			
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85001117	MN -25	9:48165
4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85000904	MN -25	9:48166
CONF-840449-	(2. symposium on resonance ionization spectroscopy and its applications, Knoxville, TN, USA, 16-20 Apr 1984)			
13	NTIS, PC A02/MF A01 (GPO Dep.)	DE85001892	MN -34A	9:48633
14	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85001118	MN -34A	9:48336
CONF-8404143-	(10. international conference on cyclotrons and their applications, East Lansing, MI, USA, 30 Apr-3 May 1984)			
23	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85001120	MN -28	9:48369
CONF-8404155-	(5. workshop on grand unification, Providence, RI, USA, 12-14 Apr 1984)			
4	*See* DOE/ER/40008-60	DE85001330	MN -34B	9:48610
CONF-8404156-	(8. symposium on aquatic toxicology, Ft. Mitchell, KY, USA, 15-19 Apr 1984)			
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85000901	MN -11	9:48504
CONF-8404174-	(TFI-TVA fertilizer technology workshop, Huntsville, AL, USA, 17-18 Apr 1984)			
4	*See* TVA/PUB-84/75	DE85900073	MN -4	9:48282
CONF-8404190-	(Warner-Brandt workshop on penetration phenomena: in elastic near-surface interaction, Oak Ridge, TN, USA, 12-13 Apr 1984)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	DE85001123	MN -34A	9:48776
2	NTIS, PC A02/MF A01 (GPO Dep.)	DE85001119	MN -34A	9:48634

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CONF-840520-	(6. international conference on plasma surface interactions in controlled fusion devices, Nagoya, Japan, 14-18 May 1984)			
20	NTIS, PC A02/MF A01 (GPO Dep.)	DE85001896	MN -20a	9:48895
CONF-840534-	(Workshop on synergistic effects in surface phenomena related to plasma-wall interactions, Nagoya, Japan, 21-22 May 1984)			
2	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84017493	MN -20c	9:48896
CONF-840561-	(17. IEEE photovoltaic specialists conference, Orlando, FL, USA, 1-4 May 1984)			
Exc.	*See* SAND-84-1167	DE84017456	MN -63	9:47609
CONF-840570-	(Materials for future energy systems conference, Washington, DC, USA, 1-3 May 1984)			
12	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85001860	MN -20d	9:48897
13	NTIS, PC A02/MF A01 (GPO Dep.)	DE85001862	MN -25	9:47958
CONF-8405113-	(Workshop on polarized targets in storage rings, Argonne, IL, USA, 17-18 May 1984)			
3	NTIS, PC A02/MF A01 (GPO Dep.)	DE85001863	MN -34C	9:48379
CONF-8405193-	(Conference on the intersections between particle and nuclear physics, Steamboat Springs, CO, USA, 23-30 May 1984)			
32	*See* LA-UR-84-2278	DE84015513	MN -34D	9:48715
41	*See* TRI-PP-84-30	DE84901557	MN -28	9:48383
42	*See* TRI-PP-84-31	DE84901559	MN -34D	9:48735
43	*See* DOE/ER/04449-52	DE85001909	MN -34C	9:48675
CONF-8405219-	(American Crystallographic Association meeting, Lexington, KY, USA, 20 May 1984)			
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85001869	MN -48	9:48523
CONF-8405231-	(International workshop on interacting boson-boson and boson-fermion systems, Gull Lake, MI, USA, 28-30 May 1984)			
2	*See* BNL-35167	DE85001353	MN -34D	9:48754
3	*See* BNL-35181	DE85001359	MN -34D	9:48766
4	*See* BNL-35154	DE85001352	MN -34D	9:48759
5	*See* BNL-35109	DE84016441	MN -34	9:48765
6	NTIS, PC A02/MF A01 (GPO Dep.)	DE85001864	MN -34C	9:48767
7	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85001895	MN -34D	9:48762
CONF-8405234-	(3. Alaska Resources conference, Seattle, WA, USA, 6-7 May 1984)			
1	Greater Seattle Chamber of Commerce, 1200 One Union Square, 6th and Univ., Seattle, WA 98101	TI84901837	MN -92a	9:47450
2	Greater Seattle Chamber of Commerce, 1200 One Union Square, 6th and Univ., Seattle, WA 98101	TI84901924	MN -13	9:47940
CONF-8405236-	(7. symposium on elementary particle physics, Kazimierz, Poland, 21-25 May 1984)			
1	*See* DOE/ER/01545-347	DE84016153	MN -34D	9:48674
CONF-840605-	(Bioenergy '84, Gothenburg, Sweden, 18-21 Jun 1984)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	DE85001274	MN -61B	9:47595
CONF-840614-	(Annual meeting of the American Nuclear Society, New Orleans, LA, USA, 3-8 Jun 1984)			
	Trans. Am. Nucl. Soc., 46: 112-113(Jun 1984)			9:47549
	Trans. Am. Nucl. Soc., 46: 106-107(Jun 1984)			9:47550
	Trans. Am. Nucl. Soc., 46: 106(Jun 1984)			9:47551
	Trans. Am. Nucl. Soc., 46: 605-606(Jun 1984)			9:47552
	Trans. Am. Nucl. Soc., 46: 605(Jun 1984)			9:47553
	Trans. Am. Nucl. Soc., 46: 643-645(Jun 1984)			9:47788
	Trans. Am. Nucl. Soc., 46: 30-31(Jun 1984)			9:48142
	Trans. Am. Nucl. Soc., 46: 627-628(Jun 1984)			9:48758
	Trans. Am. Nucl. Soc., 46: 657-658(Jun 1984)			9:48781
	Trans. Am. Nucl. Soc., 46: 655-657(Jun 1984)			9:48782
	Trans. Am. Nucl. Soc., 46: 628-630(Jun 1984)			9:48783
	Trans. Am. Nucl. Soc., 46: 630-631(Jun 1984)			9:48784
	Trans. Am. Nucl. Soc., 46: 625-627(Jun 1984)			9:48917
	Trans. Am. Nucl. Soc., 46: 631-633(Jun 1984)			9:48918
	Trans. Am. Nucl. Soc., 46: 623-625(Jun 1984)			9:48919
	Trans. Am. Nucl. Soc., 46: 622-623(Jun 1984)			9:48920
	Trans. Am. Nucl. Soc., 46: 771-772(Jun 1984)			9:48921
	Trans. Am. Nucl. Soc., 46: 770-771(Jun 1984)			9:48922
CONF-8406126-	(Robots conference, Detroit, MI, USA, 4-7 Jun 1984)			
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85001137	MN -38	9:48321
CONF-8406158-	(Intersections between nuclear and particle physics conference, Dortmund, F.R. Germany, 1 Jun 1984)			
1	*See* DOE/ER/13065-388	DE84014892	MN -34D	9:48665
CONF-8406172-	(8. Johns Hopkins conference on particle physics, Baltimore, MD, USA, 20-22 Jun 1984)			
3	*See* DOE/ER/40008-62	DE85001332	MN -34B	9:48611
CONF-8406182-	(11. international conference on neutrino physics and astrophysics, Nordkirchen bei Dortmund, F.R. Germany, 11-16 Jun 1984)			
2	*See* DOE/ER/05023-3	DE84016522	MN -34D	9:48663
CONF-8406184-	(1. workshop on colliding beam physics in China, Beijing, China, 12-21 Jun 1984)			
3	*See* LBL-17930	DE84016897	MN -34C	9:48669

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CONF-8406190-	(Theoretical workshop on electroweak symmetry breaking at the superconducting super collider, Berkeley, CA, USA, 4-22 Jun 1984)			
1	*See* BNL-35082	DE84016439	MN -34D	9:48686
CONF-8406197-	(ASTM international symposium of slurry erossion: uses, applications and test methods, Denver, CO, USA, 26-27 Jun 1984)			
1	*See* LBL-17908	DE84016905	MN -90b	9:47290
CONF-840705-	(10. international conference on cryogenic engineering, Espoo, Finland, 31 Jul-3 Aug 1984)			
4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84017469	MN -25	9:48229
CONF-840706-	(Power Engineering Society summer meeting, Seattle, WA, USA, 15-20 Jul 1984)			
5	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84015405	MN -97b	9:47761
CONF-840712-	(21. IEEE annual conference on nuclear and space radiation effects, Colorado Springs, CO, USA, 22-25 Jul 1984)			
12	*See* SAND-84-1187C	DE84016766	MN -25	9:48407
13	*See* SAND-84-0542C	DE85000066	MN -34	9:48406
CONF-840734-	(25. annual meeting of the Institute of Nuclear Materials Management, Columbus, OH, USA, 15-18 Jul 1984)			
21	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85001276	MN -4	9:48417
CONF-840738-	(Progress in quantitative NDE, San Diego, CA, USA, 8-13 Jul 1984)			
4	*See* UCRL-91422	DE84017035	MN -11	9:48603
CONF-840757-	(22. international conference on high energy physics, Leipzig, German D.R., 19-25 Jul 1984)			
9	*See* SLAC-PUB-3405	DE84017640	MN -34D	9:48716
10	*See* DOE/ER/13065-396	DE85002074	MN -34D	9:48734
11	*See* DOE/ER/13065-395	DE85002075	MN -34D	9:48666
CONF-840764-	(3. international EXAFS conference, Stanford, CA, USA, 16-20 Jul 1984)			
6	*See* BNL-35100	DE85001354	MN -34	9:48632
CONF-840778-	(7. IEA technical workshop on thermochemical processes, Toronto, Canada, 12-13 Jul 1984)			
1	*See* LA-UR-84-2188	DE84015430	MN -59a	9:47573
CONF-840786-	(9. international conference on atomic physics, Seattle, WA, USA, 23-27 Jul 1984)			
1	*See* FNAL/C-84/68-E	DE84016719	MN -28	9:48640
CONF-840788-	(International conference on the physics of highly ionized atoms, Oxford, UK, 2-5 Jul 1984)			
1	*See* LBL-18143	DE84016887	MN -34A	9:48643
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85001283	MN -34A	9:48378
CONF-840792-	(Workshop on metallic magnetism, Bad Honnef, F.R. Germany, 2-4 Jul 1984)			
1	*See* BNL-35104	DE84016433	MN -34C	9:48164
CONF-840793-	(USDOE/ORNL/PNC national topical meeting on robotics and remote handling in hostile environments, Tokyo, Japan, 24-31 Jul 1984)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85001902	MN -86	9:47473
3	NTIS, PC A02/MF A01 (GPO Dep.)	DE85001900	MN -86	9:47474
4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85001899	MN -86	9:47475
6	NTIS, PC A02/MF A01 (GPO Dep.)	DE85001898	MN -86	9:47476
CONF-840802-	(International topical meeting on fuel reprocessing and waste management, Jackson Hole, WY, USA, 26-29 Aug 1984)			
18	*See* EGG-M-26083	DE84017308	MN -70	9:47501
CONF-840804-	(Intersociety energy conversion engineering conference, San Francisco, CA, USA, 19-24 Aug 1984)			
49	*See* EGG-M-09784	DE84017223	MN -94a	9:48021
50	*See* EGG-M-24083	DE84017224	MN -66	9:47685
CONF-840805-	(188. meeting of the American Chemical Society, Philadelphia, PA, USA, 26-31 Aug 1984)			
22	NTIS, PC A02/MF A01 (GPO Dep.)	DE84017595	MN -4	9:48219
CONF-840807-	(Conference on thermodynamics, Hamilton, Canada, 13-17 Aug 1984)			
4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84016713	MN -78	9:48272
CONF-840816-	(22. national heat transfer conference, Niagara Falls, NY, USA, 5-8 Aug 1984)			
15	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84016608	MN -78	9:47837
16	*See* EGG-M-08284	DE84017229	MN -38	9:48344
17	*See* EGG-M-08084	DE84017238	MN -78	9:47844
18	*See* EGG-M-03484	DE84017225	MN -66f	9:47684
19	*See* EGG-M-23283	DE84017233	MN -78	9:47845
CONF-840819-	(Doing better: setting an agenda for the second decade, Santa Cruz, CA, USA, 14-22 Aug 1984)			
10	*See* LBL-18126	DE84016880	MN -95d	9:48023
CONF-840867-	(9. international protechnics seminar, Colorado Springs, CO, USA, 6-10 Aug 1984)			
5	*See* MLM-3182(OP)	DE84016943	MN -45	9:48176
CONF-840872-	(SPIE annual technical symposium, San Diego, CA, USA, 19-24 Aug 1984)			
27	*See* EGG-M-05984	DE84017221	MN -37	9:48404

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29	*See* SAND-84-0599C	DE85000068	MN -38	9:48338
CONF-840876-	(International conference on valence fluctuations, Koln, F.R. Germany, 27-30 Aug 1984)			
3	NTIS, PC A02/MF A01 (GPO Dep.)	DE84017485	MN -25	9:48273
CONF-840879-	(17. international conference on the physics of semiconductors, San Francisco, CA, USA, 6-10 Aug 1984)			
8	*See* SAND-84-0650C	DE85001362	MN -25	9:48236
CONF-840887-	(16. international congress on high speed photography and photonics, Strasbourg, France, 27-31 Aug 1984)			
11	*See* UCRL-90478	DE85001748	MN -37	9:48416
CONF-8408107-	(6. international conference on thin films, Stockholm, Sweden, 13-17 Aug 1984)			
1	*See* SAND-84-1663C	DE84016119	MN -25	9:48161
CONF-840901-	(ANS topical meeting on reactor physics and shielding, Chicago, IL, USA, 17-19 Sep 1984)			
10	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84017593	MN -71	9:48775
11	NTIS, PC A02/MF A01 (GPO Dep.)	DE84017453	MN -79	9:47796
12	*See* SAND-84-1789C	DE84017380	MN -80	9:48778
CONF-840905-	(Joint power generation conference, Toronto, Canada, 30 Sep-4 Oct 1984)			
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85000931	MN -95d	9:48091
CONF-840906-	(Capture gamma-ray spectroscopy conference, Knoxville, TN, USA, 10-14 Sep 1984)			
2	NTIS, PC A02/MF A01 (GPO Dep.)	DE85001759	MN -34C	9:48747
CONF-840910-	(10. international conference on plasma physics and controlled nuclear fusion research, London, UK, 12-19 Sep 1984)			
14	NTIS, PC A02/MF A01 (GPO Dep.)	DE85001855	MN -20a	9:48898
15	NTIS, PC A02/MF A01 (GPO Dep.)	DE85001110	MN -20	9:48831
CONF-840914-	(International meeting on thermal nuclear reactor safety, Karlsruhe, F.R. Germany, 10-14 Sep 1984)			
13	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84017491	MN -78	9:47838
14	*See* UCRL-91462	DE84017023	MN -78	9:47884
15	*See* SAND-84-0419C	DE84017421	MN -80	9:47882
CONF-840916-	(Robotics and remote handling in the nuclear industry conference, Toronto, Ontario, Canada, 23-27 Sep 1984)			
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85001856	MN -20	9:48899
4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85000934	MN -86	9:47477
CONF-840919-	(4. biennial NARUC regulatory information conference, Columbus, OH, USA, 5-7 Sep 1984)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84017468	MN -95d	9:48018
2	NTIS, PC A02/MF A01 (GPO Dep.)	DE84017490	MN -13	9:47978
CONF-840922-	(5. APS topical conference on high temperature plasma diagnostics, Tahoe City, CA, USA, 16-20 Sep 1984)			
3	NTIS, PC A02/MF A01 (GPO Dep.)	DE85001760	MN -20b	9:48832
4	NTIS, PC A02/MF A01 (GPO Dep.)	DE85001764	MN -20	9:48833
CONF-840924-	(4. international coal testing conference, Lexington, KY, USA, 10-13 Sep 1984)			
1	*See* TVA/OP/EDT-84/36	DE84901971	MN -90i	9:47327
CONF-840932-	(Meeting on plasma physics, Trieste, Italy, 24-28 Sep 1984)			
2	*See* UCRL-91511	DE85001739	MN -20	9:48913
CONF-840937-	(Applied superconductivity conference, San Diego, CA, USA, 9-13 Sep 1984)			
2	*See* UCRL-90638	DE84017415	MN -25	9:48324
CONF-840943-	(ISRM symposium on design and performance of underground excavations, Cambridge, UK, 3-6 Sep 1984)			
1	*See* SAND-83-1191C	DE84008027	MN -88	9:47402
CONF-840945-	(Topical conference on neutron-nucleus collisions–a probe of nuclear structure, Glouster, OH, USA, 5-8 Sep 1984)			
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84017592	MN -34C	9:48741
4	NTIS, PC A03/MF A01 (GPO Dep.)	DE84017591	MN -34C	9:48748
5	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84017483	MN -34C	9:48742
6	NTIS, PC A02/MF A01 (GPO Dep.)	DE84017482	MN -34C	9:48752
CONF-840954-	(9. national passive solar conference, Columbus, OH, USA, 23-27 Sep 1984)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	DE84016241	MN -59b	9:47630
4	*See* LA-UR-84-2638	DE84016828	MN -59b	9:47636
5	*See* LA-UR-84-2655	DE84016462	MN -59b	9:47637
CONF-840978-	(International symposium on high temperature corrosion in energy systems, Detroit, MI, USA, 17-19 Sep 1984)			
3	NTIS, PC A02/MF A01 (GPO Dep.)	DE84017459	MN -90	9:48205
CONF-8409115-	(6. annual Low-Level Waste Management Program participants information meeting, Denver, CO, USA, 11-13 Sep 1984)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84017594	MN -70B	9:48602
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84017330	MN -70B	9:47492

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3	NTIS, PC A02/MF A01 (GPO Dep.)	DE85002143	MN -70B	9:47493
CONF-8409128-	(Paul Vieille scientific meeting, Vert-le-Petit, France, 26-27 Sep 1984)			
1	*See* LA-UR-84-2752	DE84016821	MN -45	9:48418
CONF-8409130-	(International conference on surface modification of metals by ion beams, Heidelberg, F.R. Germany, 17-21 Sep 1984)			
1	*See* SAND-84-1052C	DE84017422	MN -25	9:48180
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85000936	MN -25	9:48206
CONF-8409131-	(EUROMECH 188 meeting, Leeds, UK, 24-26 Sep 1984)			
1	*See* UCRL-90831	DE85001750	MN -34	9:48654
CONF-8409134-	(4. workshop on polarized target materials and techniques, Bonn, F.R. Germany, 2-6 Sep 1984)			
1	*See* ANL-HEP-CP-84-61	DE84017486	MN -25	9:48367
CONF-8409135-	(International symposium on zeolites, Portoroz, Yugoslavia, 3-8 Sep 1984)			
1	*See* BNL-35110	DE84016431	MN -4	9:48227
CONF-8409137-	(International symposium on GaAs and related compounds, Biarritz, France, 26-28 Sep 1984)			
1	*See* SAND-84-1170C	DE85000064	MN -37	9:48414
CONF-841080-	(Joint ANS meeting, Taipei, Taiwan, 1 Oct 1984)			
1	*See* BNL-NUREG-34701	TI84012909	MN -78	9:47836
CONF-8410100-	(IEEE Industry Applications Society meeting, Chicago, IL, USA, 1-4 Oct 1984)			
1	*See* LA-UR-84-1949	DE84014041	MN -20	9:47894
CONF-8410138-	(SAE fuels and lubricants meeting, Baltimore, MD, USA, 8-11 Oct 1984)			
1	*See* LBL-18163	DE84016884	MN -96	9:48146
CONF-841103-	(International telecommunications energy conference, New Orleans, LA, USA, 11-14 Nov 1984)			
1	*See* SAND-84-0769C	DE84015708	MN -94c	9:47904
CONF-841105-	(Joint meeting of the American Nuclear Society and the Atomic Industrial Forum, Washington, DC, USA, 11-16 Nov 1984)			
10	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84014687	MN -80	9:47817
20	NTIS, PC A02/MF A01 (GPO Dep.)	DE84014721	MN -32	9:48804
29	*See* UNI-SA-101	DE84015750	MN -70A	9:47543
31	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84015836	MN -79b	9:48167
CONF-841112-	(GOMAC '84 - Government microcircuit applications conference, Las Vegas, NV, USA, 6-8 Nov 1984)			
1	*See* SAND-84-0609C	DE84016113	MN -25	9:48360
CONF-841115-	(International conference on power plant simulation, Mexico City, Mexico, 19-21 Nov 1984)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	DE84009199	MN -79	9:47839
CONF-841117-	(8. conference on the application of accelerators in research and industry, Denton, TX, USA, 12-14 Nov 1984)			
1	*See* SAND-84-1902C	DE85001903	MN -37	9:48237
2	*See* SAND-84-1347C	DE85001606	MN -25	9:48182
CONF-841120-	(Workshop on corrosion performance of nuclear fuel waste containers, Ottawa, Canada, 21-22 Nov 1984)			
1	*See* SAND-83-2372C	DE84006292	MN -70	9:48179
CONF-841121-	(AIChE annual meeting, San Francisco, CA, USA, 25-29 Nov 1984)			
1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84006551	MN -80	9:47840
2	*See* SAND-83-2209C	DE84012657	MN -4	9:47542
3	*See* SAND-83-2597C	DE84012905	MN -90d	9:47295
4	*See* LBL-17247	DE84014365	MN -25	9:48175
5	*See* UCRL-91252	DE84015042	MN -90c	9:47296
6	*See* SAND-84-7162C	DE84017088	MN -63	9:47610
CONF-841156-	(Nuclear science symposium, Orlando, FL, USA, 1 Nov 1984)			
1	*See* SAND-84-1036C	DE84012276	MN -37	9:48400
CONF-841157-	(Symposium on the scientific basis for nuclear waste management, Boston, MA, USA, 26-29 Nov 1984)			
1	*See* BNL-NUREG-34896	TI84014387	MN -70B	9:47490
2	*See* BNL-NUREG-34897	TI84014348	MN -70	9:47491
3	*See* SAND-84-1259C	DE85001792	MN -25	9:48181
CONF-841163-	(Optical materials for high power lasers meeting, Boulder, CO, USA, 14-16 Nov 1984)			
1	*See* LA-UR-84-1830	DE84013896	MN -25	9:48405
CONF-841185-	(2. international symposium on metallurgical slags and fluxes, Lake Tahoe, NV, USA, 11-15 Nov 1984)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84015822	MN -90	9:47312
CONF-850809-	(8. international conference on structural mechanics in reactor technology, Brussels, Belgium, 19-23 Aug 1985)			
1-Summ.	NTIS, PC A02/MF A01 (GPO Dep.)	DE84016320	MN -79	9:47797
COO-				
1198-559	NTIS, PC A05/MF A01 (GPO Dep.)	DE84017367	MN -25	9:48169
1199-64	*See* DOE/EV/01199-64	DE84017449	MN -11	9:48430
1422-33	*See* CONF-680444-2	DE84017611	MN -48	9:48561

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3065-388	*See* DOE/ER/13065-388	DE84014892	MN -34D	9:48665
CRPE-NT-				
110	*See* N-84-23054			9:48627
CRREL-				
84-6	*See* AD-A-139907/0			9:48425
CSIRO-DFF-IR-				
142	Commonwealth Scientific and Industrial Research Organization, Div. of Fossil Fuel, North Ryde			9:47332
D-				
12:1984	*See* PB-84-207430			9:48028
DESY-L-Trans-				
288	Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)			9:48373
DFVLR-FB-				
82-27	*See* N-84-23034			9:47616
DOE/BC/10095-				
19	NTIS, PC A13/MF A01; 1 (GPO Dep.)	DE85000103	STD -92a	9:47429
DOE/BC/10327-				
20	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE84012729	STD -92a	9:47430
DOE/BC/10823-				
6-Vol.1	NTIS, PC A09/MF A01; 1 (GPO Dep.)	DE85000102	STD -92b	9:47437
6-Vol.2	NTIS, PC A16/MF A01 (GPO Dep.)	DE85001797	STD -92b	9:47438
DOE/BP-				
243-Vol.1	NTIS, PC A13/MF A01; 1 (GPO Dep.)	DE84013181	MN -11	9:48516
244	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84017285	MN -11	9:48517
250	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84017289	MN -13	9:47979
264-Vol.1	*See* DOE/EIS-0095F-Vol.1	DE84016329	MN -11	9:48519
264-Vol.2	*See* DOE/EIS-0095F-Vol.2	DE84016330	MN -11	9:48520
292-Vol.1	NTIS, PC A14/MF A01; 1 (GPO Dep.)	DE85001924	MN -97d	9:47744
292-Vol.2	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE85001919	MN -97d	9:47745
292-Vol.3	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE85001923	MN -97d	9:47746
307	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84017115	MN -98G	9:47980
DOE/CE-				
0089	NTIS, PC A02/MF A01 (GPO Dep.)	DE84016617	MN -59b	9:47631
0099	NTIS, PC A02/MF A01 (GPO Dep.)	DE84016351	MN -59b	9:47632
12158	NTIS, PC A08/MF A01; 1 (GPO Dep.)	DE84016341	MN -95f	9:47240
DOE/CE/26409-				
T1	NTIS, PC A13/MF A01; 1 (GPO Dep.)	DE84016339	STD -95c	9:47920
DOE/CH/10122-				
22	NTIS, PC A02/MF A01 (GPO Dep.)	DE84009449	MN -59c	9:47997
DOE/CS/20238-				
T1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84017349	MN -95e	9:48129
DOE/CS/50023-				
T1	NTIS, PC A02/MF A01 (GPO Dep.)	DE84016694	MN -96	9:48156
DOE/CS/54209-				
18	NTIS, PC A10/MF A01; 1 (GPO Dep.)	DE85000326	STD -96	9:48154
DOE/CS/60014-				
4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84017579	MN -95	9:48140
5	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84017578	MN -95	9:48141
DOE/CS/66001-				
5	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE85000320	STD -61E	9:47584
6	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85000321	STD -61E	9:48249
7	NTIS, PC A03/MF A01 (GPO Dep.)	DE85000324	STD -61E	9:48297
DOE/CS/69105-				
1	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84017577	MN -96	9:48089
4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84017580	MN -95d	9:48019
DOE/DP/00789-				
T100	NTIS MF A01; 2 (GPO Dep.)	DE84017150	MN -62	9:47611
T101	NTIS MF A01; 2 (GPO Dep.)	DE84017148	MN -62	9:47612
T102	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84017151	MN -62	9:47613
DOE/DP/48015-				
1	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE84016620	MN -70	9:47494
DOE/EIS-				
0095F-Vol.1	NTIS, PC A19/MF A01 (GPO Dep.)	DE84016329	MN -11	9:48519
0095F-Vol.2	NTIS, PC A11/MF A01; 1 (GPO Dep.)	DE84016330	MN -11	9:48520
DOE/ER-				
0201	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85001916	MN -34C	9:48733
DOE/ER/01545-				
347	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84016153	MN -34D	9:48674
DOE/ER/02696-				
25	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85002059	MN -34C	9:48760
DOE/ER/04449-				
45	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85001907	MN -28	9:48662
52	NTIS, PC A02/MF A01 (GPO Dep.)	DE85001909	MN -34C	9:48675
DOE/ER/04987-				
T2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85002096	MN -4	9:48274
DOE/ER/05023-				
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84016522	MN -34D	9:48663
T2	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85001627	MN -34D	9:48664
DOE/ER/05034-				
7	NTIS, PC A02/MF A01 (GPO Dep.)	DE85001340	MN -34C	9:48729
DOE/ER/05126-				
232	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85001613	MN -34C	9:48737

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DOE/ER/05866-				
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85000052	MN -25	9:48207
DOE/ER/06030-				
5	NTIS, PC A02/MF A01 (GPO Dep.)	DE85001335	MN -4	9:48275
DOE/ER/10345-				
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85001388	MN -4	9:48276
DOE/ER/10371-				
6	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85001337	MN -34A	9:48635
DOE/ER/10396-				
4	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85002100	MN -4	9:48317
DOE/ER/10440-				
7	NTIS, PC A02/MF A01 (GPO Dep.)	DE84017323	MN -34	9:48799
DOE/ER/10493-				
15	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85000349	MN -34	9:48755
DOE/ER/10544-				
1	NTIS, PC A02/MF A01 (GPO Dep.)	DE84017326	MN -61G	9:48301
DOE/ER/10565-				
9	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE85001609	MN -34C	9:48730
DOE/ER/10618-				
11	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE85002081	MN -34A	9:48636
13	NTIS, PC A02/MF A01 (GPO Dep.)	DE85001325	MN -34A	9:48637
DOE/ER/10795-				
T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84017324	MN -63	9:47596
DOE/ER/10903-				
1	NTIS, PC A02/MF A01 (GPO Dep.)	DE82012903	MN -48	9:48524
DOE/ER/10934-				
T2	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84017357	MN -25	9:48230
DOE/ER/12051-				
T1	NTIS, PC A08/MF A01; 1 (GPO Dep.)	DE85001293	MN -25	9:48231
DOE/ER/12062-				
T1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84017256	MN -25	9:48170
DOE/ER/12098-				
2	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE85001326	MN -25	9:48159
DOE/ER/13065-				
388	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84014892	MN -34D	9:48665
395	NTIS, PC A02/MF A01 (GPO Dep.)	DE85002075	MN -34D	9:48666
396	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85002074	MN -34D	9:48734
DOE/ER/13158-				
T1	NTIS, PC A02/MF A01 (GPO Dep.)	DE84017425	MN -25	9:48247
DOE/ER/13205-				
1	NTIS, PC A05/MF A01 (GPO Dep.)	DE85001315	MN -4	9:48277
DOE/ER/40001-				
38	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84017573	MN -34A	9:48638
DOE/ER/40008-				
59	NTIS, PC A03/MF A01 (GPO Dep.)	DE85001329	MN -34D	9:48676
60	NTIS, PC A02/MF A01 (GPO Dep.)	DE85001330	MN -34B	9:48610
62	NTIS, PC A02/MF A01 (GPO Dep.)	DE85001332	MN -34B	9:48611
DOE/ER/45046-				
T1	NTIS, PC A02/MF A01 (GPO Dep.)	DE85001763	MN -25	9:48208
DOE/ER/52090-				
2	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85001387	MN -20a	9:48900
DOE/ER/53176-				
1	NTIS, PC A02/MF A01 (GPO Dep.)	DE85001338	MN -20	9:48834
DOE/ER/60100-				
3	NTIS, PC A03/MF A01 (GPO Dep.)	DE85001303	MN -92b	9:48429
4	NTIS, PC A03/MF A01 (GPO Dep.)	DE85001302	MN -92b	9:48250
5	NTIS, PC A02/MF A01 (GPO Dep.)	DE85001301	MN -92b	9:48251
DOE/ER/60118-				
2	NTIS, PC A02/MF A01 (GPO Dep.)	DE84016848	MN -23	9:48568
DOE/ER/60179-				
1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85001620	MN -48	9:48487
DOE/ER/70149-				
T3	NTIS, PC A02/MF A01 (GPO Dep.)	DE84015803	MN -34D	9:48667
DOE/ET/10069-				
T94	NTIS (US Sales Only), PC A04/MF A01; 1 (GPO Dep.)	DE85001595	STD -90d	9:47241
DOE/ET/10357-				
T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84017364	MN -25	9:48209
DOE/ET/10373-				
T11	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84017652	MN -90e	9:48366
DOE/ET/10532-				
T15	NTIS, PC A02/MF A01	DE84004987	STD -90d	9:47242
DOE/ET/10552-				
T1	NTIS, PC A02/MF A01 (GPO Dep.)	DE84017298	MN -13	9:49304
DOE/ET/10675-				
T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84017375	MN -90c	9:48171
DOE/ET/10815-				
95	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84016346	STD -90g	9:48000
99	NTIS, PC A06/MF A01 (GPO Dep.)	DE85001603	STD -90g	9:48001
DOE/ET/12044-				
55	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85000104	STD -92a	9:47431
DOE/ET/15440-				
5	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE85001783	STD -93	9:48004
8	NTIS, PC A05/MF A01 (GPO Dep.)	DE85001784	STD -93	9:48005

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T4	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85001786	STD -93	9:48006
DOE/ET/15492-				
T56	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85002077	MN -90i	9:47333
DOE/ET/17089-				
5	NTIS, PC A06/MF A01 (GPO Dep.)	DE84016278	STD -93	9:48007
DOE/ET/20356-				
12	NTIS, PC A02/MF A01 (GPO Dep.)	DE85000331	STD -63	9:47597
14	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE85000330	STD -63	9:48358
16	NTIS, PC A05/MF A01 (GPO Dep.)	DE85000328	STD -63b	9:47606
17	NTIS, PC A03/MF A01 (GPO Dep.)	DE85000327	STD -63	9:47598
DOE/ET/20643-				
T1	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84016802	MN -59a	9:47633
T2	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84017136	MN -59a	9:47634
DOE/ET/21002-				
T11	NTIS, PC A02/MF A01 (GPO Dep.)	DE84017619	MN -64	9:47625
DOE/ET/23042-				
T2	NTIS, PC A02/MF A01 (GPO Dep.)	DE84017365	MN -63	9:47599
DOE/ET/27103-				
T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84016129	MN -66	9:47654
DOE/ET/29102-				
2	NTIS, PC A99/MF A01; 1 (GPO Dep.)	DE84016956	MN -97b	9:47747
DOE/ET/34006-				
T1	NTIS (US Sales Only), PC A05/MF A01; 1 (GPO Dep.)	DE84014403	STD -78	9:47771
DOE/ET/34031-				
17	NTIS (US Sales Only), PC A04/MF A01; 1 (GPO Dep.)	DE85001803	STD -78	9:47772
DOE/ET/34034-				
107	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84016619	MN -77	9:47789
DOE/ET/53003-				
T1	NTIS, PC A02/MF A01 (GPO Dep.)	DE85001774	MN -20g	9:48835
T2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85001775	MN -20g	9:48836
DOE/ET/53088-				
155	NTIS, PC A02/MF A01 (GPO Dep.)	DE85000729	MN -20	9:48837
DOE/EV/01199-				
64	NTIS, PC A16/MF A01; 1 (GPO Dep.)	DE84017449	MN -11	9:48430
DOE/EV/04268-				
T3	NTIS, PC A04/MF A01 (GPO Dep.)	DE84017340	MN -48	9:48534
DOE/EV/10005-				
84/ 14	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85001384	MN -11	9:48608
84/ 15	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85001386	MN -11	9:48609
DOE/EV/10363-				
6	NTIS, PC A02/MF A01 (GPO Dep.)	DE85000302	MN -48	9:48535
DOE/EV/10729-				
1	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84017282	MN -11	9:48577
DOE/FC/10614-				
T9	NTIS, PC A03/MF A01 (GPO Dep.)	DE84017562	STD -90b	9:47413
DOE/FE/00016-				
T57	NTIS, PC A02/MF A01 (GPO Dep.)	DE84017354	MN -88	9:47381
DOE/FE/60181-				
1648	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84017087	STD -90a	9:47313
DOE/IA-				
0009-2-Vol.2	NTIS, PC A08/MF A01; 1 (GPO Dep.)	DE84011695	MN -13	9:47366
DOE/IA/06316-				
T2	NTIS, PC A12/MF A01; 1 (GPO Dep.)	DE84011647	MN -13	9:47368
T3	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE84011696	MN -13	9:47420
DOE/ID-				
10055(83)	NTIS, PC A13/MF A01; 1 (GPO Dep.)	DE84017409	MN -70	9:47495
DOE/ID/12148-				
T1	NTIS, PC A14; 3 (GPO Dep.)	DE84011204	STD -66	9:47727
DOE/ID/12379-				
T1	NTIS, PC A04/MF A01 (GPO Dep.)	DE84016819	STD -95f	9:48092
DOE/ID/12434-				
2	NTIS, PC A02/MF A01 (GPO Dep.)	DE84017231	MN -70B	9:47496
DOE/IG-				
0210	USDOE-TIC, PO Bx 62, Oak Ridge, TN 37830	TI85001476	STD -13	9:49305
DOE/JPL-				
1012-98	NTIS, PC A14/MF A01 (GPO Dep.)	DE85000332	STD -63b	9:47607
1012-100	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85000353	STD -63b	9:47600
1060-58	NTIS, PC A14/MF A01; 1	DE83011247	STD -62b	9:47614
DOE/LC/00022-				
1599	NTIS, PC A10/MF A01; 1 (GPO Dep.)	DE84009266	STD -90i	9:47314
DOE/LC/10787-				
130	NTIS, PC A08/MF A01; 1 (GPO Dep.)	DE85001930	STD -91	9:47462
DOE/LC/10855-				
T1	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE85000317	MN -88	9:47371
DOE/LLW-				
28T	NTIS, PC A04/MF A01 (GPO Dep.)	DE84017344	STD -70B	9:47497
35T	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84017391	STD -70B	9:47498
DOE/MA-				
0021/ 1	NTIS, PC A08/MF A01 (GPO Dep.)	DE85001361	MN -13	9:49306
DOE/MC/19196-				
1654	NTIS, PC A99/MF A01; 1 (GPO Dep.)	DE84012004	STD -90j	9:47334

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DOE/MC/20110-				
1636	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84012014	STD -90c	9:47335
DOE/METC-				
84-26-Vol.3-Pt.2	NTIS, PC A25/MF A01; 1 (GPO Dep.)	DE85001294	STD -90h	9:47351
DOE/METC/SP-				
210	NTIS, PC A03/MF A01 (GPO Dep.)	DE84009250	STD -92a	9:47425
DOE/NASA-				
0030-1	NTIS, PC A07/MF A01; 1	DE85001318	STD -96	9:48144
0032-23	NTIS, PC A10/MF A01; 1 (GPO Dep.)	DE85001322	STD -96	9:48150
0327-1	NTIS, PC A07/MF A01 (GPO Dep.)	DE85001144	STD -96	9:48157
DOE/NASA/13111-				
14-Vol.2	NTIS, PC A17/MF A01; 1 (GPO Dep.)	DE85000346	MN -90f	9:47957
DOE/NASA/50194-				
38	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85001321	STD -96	9:48145
DOE/NBB-				
0063	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84016740	STD -11	9:48444
0065	NTIS, PC A02/MF A01 (GPO Dep.)	DE84016735	STD -97	9:47762
DOE/NBM-				
4016103	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE84016103	MN -95	9:48130
4016412	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84016412	MN -11	9:47946
DOE/NDC-				
28/ U-Add.	*See* BNL-NCS-51572-Add.	DE85002134	STD -34C	9:48728
DOE/NE-				
0051/ 1	NTIS, PC A13/MF A01; 1 (GPO Dep.)	DE84017631	STD -79	9:47811
DOE/NE/32104-				
T1	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84010860	STD -80	9:47842
DOE/NE/44158-				
T2	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85001602	MN -85	9:47483
DOE/NV/10042-				
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85001598	MN -96	9:48152
DOE/NV/10250-				
15	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85001356	MN -70	9:47499
DOE/OR/00033-				
T73	NTIS, PC A12/MF A01; 1 (GPO Dep.)	DE84017139	MN -79a	9:47843
DOE/OR/03054-				
27	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85001781	MN -89	9:47243
71-Vol.2	NTIS, PC A11/MF A01; 1 (GPO Dep.)	DE85001624	MN -89	9:47336
71-Vol.3	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE85001626	MN -89	9:47337
72-Vol.1	NTIS, PC A09/MF A01; 1 (GPO Dep.)	DE85001622	MN -89	9:47244
72-Vol.2	NTIS, PC A16/MF A01; 1 (GPO Dep.)	DE85001623	MN -89	9:47245
83	NTIS, PC A14/MF A01; 1 (GPO Dep.)	DE85001615	MN -89	9:47338
92	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE85001621	MN -89	9:47246
94	NTIS, PC A16/MF A01; 1 (GPO Dep.)	DE85001630	STD -89	9:47247
116-Vol.1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85001634	STD -89	9:47315
116-Vol.2	NTIS, PC A09/MF A01; 1 (GPO Dep.)	DE85001635	STD -89	9:47316
116-Vol.3	NTIS, PC A10/MF A01; 1 (GPO Dep.)	DE85001636	STD -89	9:47317
117	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE85001637	STD -89	9:47256
118	NTIS, PC A09/MF A01; 1 (GPO Dep.)	DE85001638	STD -89	9:47257
119	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85001639	STD -89	9:47258
123	NTIS, PC A13/MF A01; 1 (GPO Dep.)	DE85001631	STD -89	9:47259
T19	NTIS, PC A09/MF A01; 1 (GPO Dep.)	DE85001618	MN -89	9:47260
T20-Vol.1	NTIS, PC A99/MF A01; 1 (GPO Dep.)	DE85000248	STD -89	9:47261
T20-Vol.2	NTIS, PC A13/MF A01; 1 (GPO Dep.)	DE85000247	STD -89	9:47262
T20-Vol.3	NTIS, PC A13/MF A01; 1 (GPO Dep.)	DE85000250	STD -89	9:47263
T20-Vol.4	NTIS, PC A20/MF A01; 1 (GPO Dep.)	DE85000201	STD -89	9:47264
T20-Vol.5	NTIS, PC A22/MF A01; 1 (GPO Dep.)	DE85000249	STD -89	9:47265
DOE/OR/21390-				
T1	NTIS, PC A11/MF A01; 1 (GPO Dep.)	DE84017296	MN -61D	9:47998
DOE/OR/21400-				
T44	NTIS, PC A02/MF A01 (GPO Dep.)	DE84017618	MN -90h	9:48210
DOE/PC/30013-				
T6	NTIS, PC A12/MF A01; 1 (GPO Dep.)	DE84016499	STD -90a	9:47318
DOE/PC/50001-				
28	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85001160	STD -90d	9:47266
32	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85001162	STD -90d	9:47267
33	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85001161	STD -90d	9:47268
34	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85001163	STD -90d	9:47269
35	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85001164	STD -90d	9:47270
DOE/PC/50033-				
T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84015439	STD -90b	9:47271
DOE/PC/50046-				
11	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84017339	STD -90d	9:47272
13	NTIS, PC A10/MF A01; 1 (GPO Dep.)	DE85001355	STD -90d	9:47274
14	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84017034	STD -90d	9:47275
DOE/PC/50788-				
T5	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85001790	STD -90b	9:47319
DOE/PC/60019-				
3	NTIS, PC A03/MF A01 (GPO Dep.)	DE85001381	STD -90d	9:47276
DOE/PC/60039-				
3	NTIS, PC A02/MF A01 (GPO Dep.)	DE84016520	MN -90d	9:47277
DOE/PC/60048-				
3	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84016496	STD -90d	9:47278
DOE/PC/60265-				
T4	NTIS, PC A02/MF A01 (GPO Dep.)	DE84017305	MN -90a	9:47757

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DOE/PC/60271-				
3	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84016280	STD -90i	9:47339
DOE/PC/60781-				
4	NTIS, PC A03/MF A01 (GPO Dep.)	DE84017055	STD -90d	9:47279
DOE/PC/60784-				
T2	NTIS, PC A02/MF A01 (GPO Dep.)	DE84016498	STD -90d	9:47281
DOE/PC/60801-				
T3	NTIS, PC A02/MF A01 (GPO Dep.)	DE84016294	MN -90e	9:47414
DOE/PC/62999-				
3	NTIS, PC A02/MF A01 (GPO Dep.)	DE84017382	MN -90a	9:47418
DOE/PETC/QTR-				
84/ 3	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE85001441	MN -90	9:47282
DOE/PR/06010-				
T34	NTIS, PC A02/FM A01; 1 (GPO Dep.)	DE85001604	MN -34A	9:48639
DOE/R8/01058-				
T1	NTIS, PC A04; 3 (GPO Dep.)	DE84015668	MN -95d	9:47635
DOE/R8/07017-				
T1	NTIS, PC A02/MF A01 (GPO Dep.)	DE84015415	MN -97e	9:47591
DOE/RA/32012-				
T9	NTIS, PC A08/MF A01; 1 (GPO Dep.)	DE84006951	STD -91	9:47464
DOE/RA/50260-				
1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85001915	MN -97	9:47981
DOE/RA/50276-				
1	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE85002122	MN -97	9:47741
DOE/RG/10206-				
T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84016832	MN -97	9:47751
DOE/RG/10268-				
T5	NTIS, PC A04/MF A01 (GPO Dep.)	DE84016518	MN -98	9:47961
DOE/RL/01830-				
T28	NTIS, PC A03/MF A01 (GPO Dep.)	DE84017563	MN -90	9:47283
DOE/S-				
0030	NTIS, PC A02/MF A01 (GPO Dep.)	DE85001363	MN -13	9:47962
DOE/SF/00098-				
T4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85001756	MN -37	9:48410
DOE/SF/10501-				
062	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84017039	MN -62a	9:47615
DOE/SF/10855-				
T2	NTIS, PC A08/MF A01; 1 (GPO Dep.)	DE84016519	MN -66a	9:47672
DOE/SF/10856-				
T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84016527	MN -95	9:48020
DOE/SF/11937-				
T1	NTIS, PC A06/MF A01 (GPO Dep.)	DE84016587	MN -62	9:47646
DOE/TIC-				
3396-Suppl.1	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE84013561	STD -70	9:47478
DOE/TIC/EGC-				
84/ 2	NTIS$8.00 single copy (subscription item)	TI84013097	ND -13	9:49323
DOT-I-				
82-24	NTIS, PC A07/MF A01; 1	DE84901217	MN -96	9:48090
DPST-				
84-528	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84015771	MN -22	9:48278
DREO-				
877	*See* AD-A-141791/4			9:47826
DRNR-P-				
270	*See* CEA-CONF-7156	DE84751752	MN -79	9:47794
271	*See* CEA-CONF-7157	DE84751751	MN -80	9:47795
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646	NTIS (US Sales Only), PC A03/MF A01	DE84751753	MN -80	9:47804
E-				
2016	*See* N-84-23022			9:47898
2037	*See* N-84-23024			9:47899
2041	*See* N-84-23023			9:48011
2051	*See* N-84-23026			9:47901
2052	*See* N-84-23025			9:47900
2110	*See* N-84-23027			9:47601
EAS-G-				
5/ 83	*See* IEA/CREAS-84/09			9:47417
EGG-				
2298	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84017387	STD -70	9:47818
2304	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE85001317	STD -70	9:47500
2312	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85001918	STD -70	9:47554
EGG-M-				
03484	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84017225	MN -66f	9:47684
05984	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84017221	MN -37	9:48404
08084	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84017238	MN -78	9:47844
08284	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84017229	MN -38	9:48344
09784	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84017223	MN -94a	9:48021
23283	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84017233	MN -78	9:47845
24083	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84017224	MN -66	9:47685
26083	NTIS, PC A02/MF A01 (GPO Dep.)	DE84017308	MN -70	9:47501
EMD-				
2-67-1139(S)	*See* NMERDI-4012202	DE84012202	MN -70	9:47533
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600/ D-84-150	*See* PB-84-201615			9:48590
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EPA/600-				
D-84-138	*See* PB-84-194612			9:48507
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EPA/600/4-				
84-049	*See* PB-84-199926			9:47677
EPRI-AP-				
3579	NTIS, PC A09/MF A01; 1 - EPRI (GPO Dep.)	DE85001912	MN -90d	9:47284
EPRI-CS-				
2931	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920048	ND -90h	9:47778
3541	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI84920532	ND -93	9:48172
3636	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920018	ND -90i	9:47340
3666	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920001	ND -90b	9:47408
EPRI-EA-				
3604	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920035	ND -98E	9:47994
3625	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920021	ND -98	9:47960
3637	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920045	ND -98E	9:47982
3653-CCM	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920010	ND -98E	9:47983
3672	NTIS, PC A09/MF A01; 1 - EPRI (GPO Dep.)	DE85001913	MN -90i	9:48578
3674	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920047	ND -90i	9:47341
3681	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920002	ND -11	9:48497
3683	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920003	ND -97	9:47984
EPRI-EL-				
3089-SY	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920033	ND -97	9:49315
3089-Vol.3	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920030	ND -97	9:49316
3501	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920026	ND -97a	9:47763
3581	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI84920501	ND -97	9:47925
3608-CCM-Vol.2	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920036	ND -97a	9:47764
3608-Vol.1	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920032	ND -97a	9:47765
3643	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI84920475	ND -97a	9:47766
3667	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920039	ND -97	9:47752
3668	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920027	ND -97	9:47742
EPRI-EM-				
3656	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920022	ND -95f	9:48093
EPRI-NP-				
3274-Vol.2	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920016	ND -78	9:47779
3274-Vol.4	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920017	ND -78	9:47780
3274-Vol.5	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920023	ND -78	9:47781
3573-SR	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920013	ND -78	9:47846
3613-Vol.1	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920044	ND -78	9:47847
3613-Vol.2	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920043	ND -78	9:47848
3614-Vol.2	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI84920513	ND -78	9:47773
3616-Vol.1	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI84920547	ND -80	9:47819
3642-SR	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920019	ND -78	9:47782
3659	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920046	ND -80	9:47823
3677	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920029	ND -78	9:47849
3682	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920042	ND -85	9:47484
3687	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920028	ND -78	9:47774

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3691	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920005	ND -80	9:47820
ERG-				
046	*See* PB-84-205681			9:48147
ESA-TT-				
807	*See* N-84-23034			9:47616
ETEC-TDR-				
84-6	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85001933	MN -78	9:47850
EUR-				
8505-DE-EN	*See* PB-84-214618			9:48148
8795-FR	European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037			9:47382
8825-DE	European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037			9:47383
8826-FR	European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037			9:47384
8827-EN	European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037			9:47385
8860-EN	*See* PB-84-206671			9:48101
8874-DE	European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037			9:47409
8875-DE	European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037			9:47342
8876-DE	European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037			9:47343
9014-EN	European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037			9:47386
9040-EN	European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037			9:47387
9044-EN	European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037			9:47285
9047-EN	European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037			9:47286
9048-FR	European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037			9:47287
9053-DE	European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037			9:47288
9054-DE	European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037			9:47289
9055-EN	European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037			9:47320
9059-FR	European Community Information Service, 2100 M St., NW, Suite 707, Washington, DC 20037			9:47410
EUR-CEA-FC-				
1205	NTIS (US Sales Only), PC A11/MF A01	DE84751748	MN -20	9:48838
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3765	*See* DOE/ET/15440-8	DE85001784	STD -93	9:48005
4031	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85001785	STD -93	9:48008
4267	*See* DOE/ET/15440-T4	DE85001786	STD -93	9:48006
6262F	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE85001341	MN -93	9:48009
FE-				
2299-17	*See* DOE/ET/10675-T1	DE84017375	MN -90c	9:48171
2315-96	*See* DOE/ET/10532-T15	DE84004987	STD -90d	9:47242
2579-14	*See* DOE/ET/10373-T11	DE84017652	MN -90e	9:48366
2664-11	*See* DOE/ET/10357-T1	DE84017364	MN -25	9:48209
2893-136	*See* DOE/ET/10069-T94	DE85001595	STD -90d	9:47241
FHWA/RD-				
83/ 012	*See* PB-84-195239			9:48235
FJSRL-TR-				
83-0006	*See* AD-A-141751/8			9:48291
FNAL/C-				
84/ 68-E	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84016719	MN -28	9:48640
FNAL-TM-				
1280	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85001364	MN -28	9:48374
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40189-B4	*See* PB-84-206028			9:47448
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1345	NTIS (US Sales Only), PC A02/MF A01	DE84751762	MN -20	9:48901
1356	NTIS (US Sales Only), PC A06/MF A01	DE84751741	MN -37	9:48390
1408	NTIS (US Sales Only), PC A09/MF A01	DE84751760	MN -34A	9:48641
1455	NTIS (US Sales Only), PC A07/MF A01	DE84751763	MN -48	9:48352
1530	NTIS (US Sales Only), PC A02/MF A01	DE84751761	MN -34D	9:48391
1535	NTIS (US Sales Only), PC A06/MF A01	DE84751749	MN -34B	9:48612
FWS/OBS-				
80/ 40.5	NTIS, PC A04/MF A01 - GPO*	TI84901664	MN -11	9:48505
80/ 40.6	NTIS, PC A05/MF A01 - GPO*	TI84901661	MN -11	9:48489
80/ 40.10	NTIS, PC A05/MF A01	TI84901672	MN -11	9:48445
82/ 61	NTIS, PC A03/MF A01	TI84901889	MN -11	9:47441
GAO/HRD-				
84-64	US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760	TI84901895	MN -13	9:47921
GAO/RCED-				
84-7	US General Accounting Office, PO Box 6015, Gaithersburg, MD 20760	TI84901869	MN -11	9:47926

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84-21	US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760	TI84901488	MN -86	9:47479
84-84	US General Accounting Office, PO Box 6015, Gaithersburg, MD 20760	TI84901868	MN -11	9:47927
84-126	US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760	TI85900086	MN -97e	9:47592
84-156	US General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760	TI84901487	MN -2	9:47485
GC-TR-				
83-249	*See* AD-A-141885/4			9:48402
GCA-TR-				
83-41-G	*See* PB-84-190990			9:47447
GEAP-				
25163-9	NTIS (US Sales Only), PC A02/MF A01; 1 (GPO Dep.)	DE84017502	STD -78	9:47822
30643	*See* DOE/ET/34031-17	DE85001803	STD -78	9:47772
GEND-INF-				
055	NTIS, PC A03/MF A01 (GPO Dep.)	DE84017410	MN -78	9:47851
GESR-				
2089	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE84017371	MN -25	9:47802
GJ/TMC-				
16	NTIS, PC A08/MF A01; 1 (GPO Dep.)	DE85000354	STD -70A	9:47502
GJBX-				
7-84	NTIS, PC A15/MF A01; 1 (GPO Dep.)	DE85001342	MN -51	9:47470
GKSS-				
83-E-42	*See* N-84-23035			9:47733
83-E-60	*See* N-84-24019			9:48446
84/ E/ 14	Nucl. Instrum. Methods Phys. Res., Sect. A (1 Mar 1984) v. 220(2/3) p. 517-524			9:47569
GRS-				
56	Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)			9:47852
GRS-A-				
588	Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Garching (Germany, F.R.)			9:49317
635	Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Garching (Germany, F.R.)			9:47853
639	Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Garching (Germany, F.R.)			9:47854
844	Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Garching (Germany, F.R.)			9:47855
GRS-F-				
122	Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)			9:47856
GSF-R-				
328	Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.)			9:48500
GV-				
58-27-30	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84012619	MN -33	9:47830
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84-3	*See* PB-84-214352			9:47461
HRP-				
0904924/ 8	NTIS, PC A05/MF A01			9:48536
HW-				
76661	NTIS, PC A02/MF A01 (GPO Dep.)	DE84017368	MN -80	9:47829
IEA/CREAS-				
84/ 09	NTIS PC $50.00			9:47417
IIASA-RR-				
83-33	NTIS	TI84901660	ND -11	9:47922
INIS-BR-				
121	NTIS (US Sales Only), PC A08/MF A01	DE84780533	MN -41	9:48790
122	NTIS (US Sales Only), PC A03/MF A01	DE84780532	MN -34D	9:48714
INIS-mf-				
4754(No.24)	NTIS (US Sales Only), PC A05/MF A01	DE84780556	MN -20	9:48807
8783	NTIS (US Sales Only), PC A10/MF A01	DE84780561	MN -34B	9:48613
8785	NTIS (US Sales Only), PC A05/MF A01	DE84780580	MN -41	9:48795
8787	NTIS (US Sales Only), PC A05/MF A01	DE84780570	MN -4	9:48308
8789	NTIS (US Sales Only), PC A05/MF A01	DE84780566	MN -34C	9:48763
8790	NTIS (US Sales Only), PC A03/MF A01	DE84780583	MN -48	9:48559
8793	NTIS (US Sales Only), PC A06/MF A01	DE84780574	MN -48	9:48546
8794	NTIS (US Sales Only), PC A04/MF A01	DE84780584	MN -48	9:48547
8796	NTIS (US Sales Only), PC A05/MF A01	DE84780563	MN -34C	9:48743
8800	NTIS (US Sales Only), PC A05/MF A01	DE84780581	MN -41	9:48548
8802	NTIS (US Sales Only), PC A03/MF A01	DE84780576	MN -23	9:48560
8803	NTIS (US Sales Only), PC A06/MF A01	DE84780577	MN -23	9:48528
8804	NTIS (US Sales Only), PC A06/MF A01	DE84780585	MN -48	9:48549
8805	NTIS (US Sales Only), PC A05/MF A01	DE84780586	MN -48	9:48550
8806	NTIS (US Sales Only), PC A06/MF A01	DE84780562	MN -34C	9:48768
8807	NTIS (US Sales Only), PC A05/MF A01	DE84780578	MN -23	9:48562
8808	NTIS (US Sales Only), PC A04/MF A01	DE84780587	MN -48	9:48551
8810	NTIS (US Sales Only), PC A04/MF A01	DE84780582	MN -41	9:48552
8811	NTIS (US Sales Only), PC A04/MF A01	DE84780588	MN -48	9:48553
8836	NTIS (US Sales Only), PC A11/MF A01	DE84780575	MN -48	9:49327
8853	NTIS (US Sales Only), PC A05/MF A01	DE84780589	MN -48	9:48796

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8854	NTIS (US Sales Only), PC A05/MF A01	DE84780590	MN -48	9:48554
8855	NTIS (US Sales Only), PC A07/MF A01	DE84780569	MN -4	9:48252
8856	NTIS (US Sales Only), PC A09/MF A01	DE84780591	MN -48	9:48555
8858	NTIS (US Sales Only), PC A07/MF A01	DE84780567	MN -4	9:48253
8859	NTIS (US Sales Only), PC A08/MF A01	DE84780573	MN -34B	9:48279
8860	NTIS (US Sales Only), PC A04/MF A01	DE84780592	MN -48	9:48556
8862	NTIS (US Sales Only), PC A05/MF A01	DE84780571	MN -25	9:48232
8863	NTIS (US Sales Only), PC A06/MF A01	DE84780559	MN -20	9:48902
8864	NTIS (US Sales Only), PC A07/MF A01	DE84780572	MN -51	9:48485
8865	NTIS (US Sales Only), PC A07/MF A01	DE84780565	MN -34C	9:48642
8876	NTIS (US Sales Only), PC A10/MF A01	DE84780614	MN -2	9:47928
8878	NTIS (US Sales Only), PC A02/MF A01	DE84780557	MN -20	9:48839
8879	NTIS (US Sales Only), PC A08/MF A01	DE84780616	MN -2	9:47923
9040	NTIS (US Sales Only), PC A15/MF A01	DE84780568	MN -4	9:47530
9041	NTIS (US Sales Only), PC A02/MF A01	DE84780554	MN -34D	9:48678
9044	NTIS (US Sales Only), PC A02/MF A01	DE84780615	MN -2	9:47564
9048	NTIS (US Sales Only), PC A05/MF A01	DE84780564	MN -34C	9:48745
9049	NTIS (US Sales Only), PC A06/MF A01	DE84780579	MN -23	9:48557
9055	NTIS (US Sales Only), PC A02/MF A01	DE84780618	MN -2	9:47783
9056	NTIS (US Sales Only), PC A03/MF A01	DE84780620	MN -2	9:48424
9062	NTIS (US Sales Only), PC A02/MF A01	DE84780619	MN -2	9:49326
INIS-SU-				
213	NTIS (US Sales Only), PC A03/MF A01	DE84780560	MN -20	9:48322
247	NTIS (US Sales Only), PC A11/MF A01	DE84780555	MN -34A	9:48174
IWGFPT-				
18	NTIS (US Sales Only), PC A11/MF A01; 1	DE84901766	MN -78	9:47775
JEN-				
212-DQ/ I-74	NTIS (US Sales Only), PC A02/MF A01; 1	DE84901929	MN -4	9:48506
JINR-				
P4-6074	NTIS (US Sales Only), PC A02/MF A01; 1	DE84901967	MN -34	9:48805
JPL-				
9950-912	*See* DOE/CS/54209-18	DE85000326	STD -96	9:48154
9950-926	*See* DOE/CS/66001-7	DE85000324	STD -61E	9:48297
9950-927	*See* DOE/CS/66001-6	DE85000321	STD -61E	9:48249
9950-928	*See* DOE/CS/66001-5	DE85000320	STD -61E	9:47584
JPL-PUB-				
83-2	*See* DOE/JPL-1060-58	DE83011247	STD -62b	9:47614
84-35	*See* DOE/ET/20356-14	DE85000330	STD -63	9:48358
84-37	*See* DOE/ET/20356-16	DE85000328	STD -53b	9:47606
84-40	*See* DOE/ET/20356-12	DE85000331	STD -63	9:47597
84-41	*See* DOE/ET/20356-17	DE85000327	STD -63	9:47598
84-44	*See* DOE/JPL-1012-98	DE85000332	STD -63b	9:47607
84-52	*See* DOE/JPL-1012-100	DE85000353	STD -63b	9:47600
K/PS-				
819	NTIS, PC A02/MF A01 (GPO Dep.)	DE84017575	MN -22	9:47472
KFK-				
131-11	Gesellschoft Fuer Kernforschung, Karlsruhe, West Germany	TI84901927	ND -51	9:48313
1742	NTIS (US Sales Only), PC A02/MF A01; 1	DE84901928	MN -70	9:47531
KLX-				
1044	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84017624	MN -38	9:48323
LA-				
9236-NERP	NTIS, PC A08/MF A01; 1 (GPO Dep.)	DE84010095	STD -11	9:48486
10004	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84017090	STD -38	9:48359
10006-PR	NTIS, PC A06/MF A01 (GPO Dep.)	DE84016972	STD -70	9:47532
10096-MS	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84016981	STD -33A	9:47572
10120-PR	NTIS, PC A02/MF A01 (GPO Dep.)	DE84016983	STD -79b	9:47798
LA-tr-				
68-24	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84017373	MN -4	9:48217
84-41	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85001313	MN -37	9:47570
LA-UR-				
84-1830	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84013896	MN -25	9:48405
84-1949	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84014041	MN -20	9:47894
84-2188	NTIS, PC A02/MF A01 (GPO Dep.)	DE84015430	MN -59a	9:47573
84-2278	NTIS, PC A02/MF A01 (GPO Dep.)	DE84015513	MN -34D	9:48715
84-2638	NTIS, PC A02/MF A01 (GPO Dep.)	DE84016828	MN -59b	9:47636
84-2655	NTIS, PC A02/MF A01 (GPO Dep.)	DE84016462	MN -59b	9:47637
84-2752	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84016821	MN -45	9:48418
LAMS-				
1870-Del.	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84016834	MN -33	9:47831
2893	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84016874	MN -80	9:47832
LBL-				
17055	NTIS, PC A04/MF A01 (GPO Dep.)	DE85001921	STD -95d	9:48022
17247	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84014365	MN -25	9:48175
17675	NTIS, PC A07/MF A01 (GPO Dep.)	DE85001925	STD -66	9:47725
17899	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84014589	MN -34D	9:48668
17908	NTIS, PC A03/MF A01 (GPO Dep.)	DE84016905	MN -90b	9:47290
17915	NTIS, PC A02/MF A01 (GPO Dep.)	DE85001299	STD -37	9:48397
17930	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84016897	MN -34C	9:48669
18091	NTIS, PC A13/MF A01; 1 (GPO Dep.)	DE84016768	MN -98E	9:47913
18092	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85000202	MN -20	9:48903
18126	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84016880	MN -95d	9:48023
18143	NTIS, PC A02/MF A01 (GPO Dep.)	DE84016887	MN -34A	9:48643
18163	NTIS, PC A02/MF A01 (GPO Dep.)	DE84016884	MN -96	9:48146

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18278	NTIS, PC A05/MF A01 (GPO Dep.)	DE85002066	MN -4	9:48292
LBL-PUB-				
475	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85000386	MN -37	9:48413
LR-				
404(AP) -M	*See* PB-84-204833			9:48468
463(OP) -M	*See* PB-84-201532			9:47348
470(AP) -M	*See* PB-84-204825			9:48467
472(OP) -M	*See* PB-84-201359			9:47347
474(AP) -M	*See* PB-84-204841			9:48469
475(AP) -M	*See* PB-84-204858			9:48470
476(AP) -M	*See* PB-84-204866			9:48471
478(AP) -M	*See* PB-84-204767			9:48466
479(AP) -M	*See* PB-84-201342			9:47589
484(AP) -M	*See* PB-84-201524			9:48461
MCR-				
83-553-Vol.1	*See* AD-A-141631/2			9:49310
83-553-Vol.2	*See* AD-A-141632/0			9:49311
MHD-III-				
84-073	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84017228	STD -90g	9:48010
MINTEK-M-				
140	*See* PB-84-197094			9:47363
MLM-				
3182(OP)	NTIS, PC A02/MF A01 (GPO Dep.)	DE84016943	MN -45	9:48176
MLM-MU-				
50-67-0008	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84016687	MN -70	9:48270
84-69-0002	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85001879	MN -25	9:48234
MR-				
10064-O1	*See* DOE/ET/23042-T2	DE84017365	MN -63	9:47599
MRC-TSR-				
2659	*See* AD-A-141490/3			9:47833
2669	*See* AD-A-141728/6			9:47992
2672	*See* AD-A-141750/0			9:48316
MTI-				
84-SESD-14	NTIS, PC A02/MF A01 (GPO Dep.)	DE84017263	MN -96	9:48151
MTR-				
80W76-01-Vol.1-Summ.	NTIS, PC A04/MF A01 (GPO Dep.)	DE84012986	MN -90f	9:47756
80W76-02	NTIS, PC A12/MF A01 (GPO Dep.)	DE84012981	MN -90f	9:47753
N-				
84-23021	NTIS, PC A03/MF A01			9:47608
84-23022	NTIS, PC A02/MF A01			9:47898
84-23023	NTIS, PC A02/MF A01			9:48011
84-23024	NTIS, PC A02/MF A01			9:47899
84-23025	NTIS, PC A02/MF A01			9:47900
84-23026	NTIS, PC A02/MF A01			9:47901
84-23027	NTIS, PC A02/MF A01			9:47601
84-23028	NTIS, PC A07/MF A01			9:47895
84-23034	NTIS, PC A06/MF A01			9:47616
84-23035	NTIS, PC A03/MF A01			9:47733
84-23039	NTIS, PC A02/MF A01			9:48624
84-23041	NTIS, PC A03/MF A01			9:48625
84-23050	NTIS, PC A02/MF A01			9:48426
84-23051	NTIS, PC A02/MF A01			9:48427
84-23053	NTIS, PC A05/MF A01			9:48626
84-23054	NTIS, PC A03/MF A01			9:48627
84-23866	NTIS, PC A03/MF A01			9:48398
84-23937	NTIS, PC A04/MF A01			9:47947
84-23938	NTIS, PC A04/MF A01			9:47421
84-23960	NTIS, PC A04/MF A01			9:47422
84-23961	NTIS, PC A04/MF A01			9:47426
84-23962	NTIS, PC A04/MF A01			9:47948
84-23963	NTIS, PC A04/MF A01			9:47373
84-23972	NTIS, PC A04/MF A01			9:47427
84-23988	NTIS, PC A03/MF A01			9:47665
84-24019	NTIS, PC A06/MF A01			9:48446
84-24022	NTIS, PC A03/MF A01			9:48481
84-24023	NTIS, PC A03/MF A01			9:48482
84-24433	NTIS, PC A11/MF A01			9:48337
8424021	NTIS, PC A03/MF A01			9:48483
NASA-CR-				
167890	*See* N-84-23021			9:47608
168255	*See* DOE/NASA-0030-1	DE85001318	STD -96	9:48144
171780	*See* N-84-23028			9:47895
173419	*See* N-84-23039			9:48624
174655	*See* DOE/NASA-0327-1	DE85001144	STD -96	9:48157
174674	*See* DOE/NASA-0032-23	DE85001322	STD -96	9:48150
NASA-TM-				
81401-Vol.2	*See* DOE/NASA/13111-14-Vol.2	DE85000346	MN -90f	9:47957
83618	*See* N-84-23026			9:47901
83638	*See* DOE/NASA/50194-38	DE85001321	STD -96	9:48145
83643	*See* N-84-23025			9:47900
83647	*See* N-84-23024			9:47899
83651	*See* N-84-23022			9:47898
83664	*See* N-84-23023			9:48011

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83667	*See* N-84-23027			9:47601
86063	*See* N-84-23041			9:48625
86092	*See* N-84-23866			9:48398
NBS-MONO-				
172	*See* PB-84-202647			9:47457
NBS-SP-				
670	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE84017607	MN -98	9:47914
NBSIR-				
84-2898	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84017001	MN -97	9:47767
NCEL-TN-				
1695	*See* AD-A-142314/4			9:47587
NEDM-				
14103	NTIS, PC A02/MF A01 (GPO Dep.)	DE84017295	MN -79a	9:47799
NERDDP-CS-				
83-9	National Energy Research, Development and Demonstration Council, Canberra, Australia			9:47291
83-10	National Energy Research, Development and Demonstration Council, Canberra, Australia			9:47361
NERDDP-EG-				
83-177	National Energy Research, Development and Demonstration Council, Canberra, Australia			9:47374
83-182	National Energy Research, Development and Demonstration Council, Canberra, Australia			9:47375
NMAB-				
411	NTIS, PC A09/MF A01; 1 (GPO Dep.)	DE85000734	MN -96	9:48012
NMERDI-				
2-68-2215	NTIS, PC A06/MF A01; 1 - NMERDI Univ. of New Mexico, 457 Washington SE, Albuquerque 87108	DE84901654	MN -60	9:47734
4012202	NTIS, PC A05/MF A01 (GPO Dep.)	DE84012202	MN -70	9:47533
NP-				
24480	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI84920514	ND -98E	9:47987
24481	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI84920515	ND -98E	9:47988
4901337	NTIS, PC A04/MF A01	DE84901337	MN -92	9:47435
4901482	NTIS (US Sales Only), PC A04/MF A01; 1	DE84901482	MN -77	9:47790
4901484	NTIS (US Sales Only), PC A02/MF A01; 1	DE84901484	MN -77	9:47791
4901485	NTIS (US Sales Only), PC A03/MF A01; 1	DE84901485	MN -77	9:47792
4901544	NTIS, PC A99/MF A01	TI84901544	MN -11	9:48521
4901642	NTIS (US Sales Only), PC A02/MF A01; 1	DE84901642	MN -77	9:47793
4901793	Dept. of Development, Div. of Energy, P.O. Box 1001, Columbus, OH 43216	TI84901793	MN -96	9:48158
4901799	Department of Development, P.O. Box 1001, Columbus, OH 43216	TI84901799	MN -95f	9:48094
4901848	Gas Processors Association, 1812 First Place, Tulsa, OK 74103	TI84901848	MN -92	9:47578
4901851	North Carolina Dept. of Commerce, Energy Div., 430 N. Salisbury St., Raleigh, NC 27611	TI84901851	MN -98	9:47995
4901876	South Dakota Office of Energy Policy, State Capital Street, Pierre, SD	TI84901876	MN -66g	9:48024
4901880	SOMED-Box 6282, Univ. of Alabama, University (Tuscaloosa), AL 35486, $3.00	TI84901880	MN -25	9:48177
4901915	Executive Director-NAPAP, 726 Jackson Place, N.W., Washington, DC 20503	TI84901915	MN -11	9:47929
4901954	NTIS, PC A12/MF A01	TI84901954	MN -11	9:48501
5900047	NTIS, PC A02/MF A01	DE85900047	MN -98B	9:47974
5900048	NTIS, PC A02/MF A01	DE85900048	MN -98B	9:47975
5900084	NTIS, PC A06/MF A01; 1	DE85900084	MN -11	9:48605
NPS-				
55-84-004	*See* AD-A-141719/5			9:47769
NRL-MR-				
5213	*See* AD-A-142448/0			9:48403
5275	*See* AD-A-141539/7			9:48389
5296	*See* AD-A-141464/8			9:48809
5327	*See* AD-A-141840/9			9:48368
5330	*See* AD-A-141568/6			9:48810
5440	NTIS, PC A02/MF A01 (GPO Dep.)	DE85000206	MN -20	9:48904
NSF-				
81-324	National Science Foundation, Washington, DC 20550	TI84901906	MN -13	9:49307
NUREG-				
0430-Vol.4-No.2	NTIS, PC A02/MF A01 - GPO*	TI84901878	MN -15	9:47567
0540-Vol.6-No.7	NTIS, PC A99/MF A01 - GPO*	TI85900028	MN -2	9:47805
0748-Vol.4-No.7	NTIS, PC A18/MF A01 - GPO*	TI84901916	MN -2	9:47806
0750-Vol.19-Index.1	NTIS, PC A04/MF A01 - GPO*	TI84901957	MN -80	9:47807
0787-Suppl.7	NTIS, PC A25/MF A01 - GPO* $11.00	TI85900030	MN -78	9:47858
0926-Rev.1	NTIS, PC A23/MF A01 - GPO* $10.00	TI85900070	MN -78	9:47859
0935	NTIS, PC A03/MF A01 = GPO* $3.75	TI85900054	MN -4	9:48281
0978-F	NTIS, PC A05/MF A01 - GPO* $4.75	TI85900064	MN -78	9:47860
1054	NTIS, PC A06/MF A01 - GPO* $5.00	TI84901882	MN -80	9:47861
1061-Vol.1	NTIS, PC A17/MF A01 - GPO* $8.50	TI85900069	MN -78	9:47776
1068	NTIS, PC A06/MF A01 - GPO* $5.00	TI84901884	MN -78	9:47862
1080-Vol.1	NTIS, PC A09/MF A01 - GPO* $6.00	TI85900050	MN -80	9:47808

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NUREG/CR-				
1799	NTIS, PC A07/MF A01 - GPO	TI84017650	MN -80	9:47863
1829	NTIS, PC A02/MF A01 - GPO	TI84017651	MN -78	9:47784
2000-Vol.3-No.8	NTIS, PC A04/MF A01 - GPO	TI85001935	MN -80	9:47864
2159	NTIS, PC A08/MF A01 - GPO	TI84017627	MN -78	9:47865
2189-Vol.1	NTIS, PC A04/MF A01 - GPO	TI84017628	MN -78	9:47866
2331-Vol.3-No.4	NTIS, PC A07/MF A01 - GPO (GPO Dep.)	TI84016812	MN -80	9:47867
2499	NTIS, PC A04/MF A01 - GPO $4.50	TI84017319	MN -15	9:47568
3169	NTIS, PC A20/MF A01 - GPO	TI84017268	MN -79	9:47868
3190	NTIS, PC A08/MF A01 - GPO	TI85001945	MN -79	9:47869
3418	NTIS, PC A12/MF A01 - GPO	TI85001389	MN -78	9:47870
3460	NTIS PC E07/MF A01 - GPO	TI84015734	MN -78	9:47871
3469-Vol.1	NTIS, PC A07/MF A01 - GPO	TI84017271	MN -41	9:47872
3513	NTIS, PC A03/MF A01 - GPO	TI84017460	MN -80	9:47825
3617	NTIS, PC A09/MF A01 - GPO	TI84016399	MN -78	9:47873
3660-Vol.2	NTIS, PC A04/MF A01 - GPO (GPO Dep.)	TI84014704	MN -38	9:47874
3665-Vol.1	NTIS, PC A04/MF A01 - GPO* $4.50	TI85900067	MN -78	9:47875
3665-Vol.2	NTIS, PC A03/MF A01 - GPO* $4.00	TI85900066	MN -78	9:47876
3665-Vol.3	NTIS, PC A10/MF A01 - GPO* $6.50	TI85900065	MN -78	9:47877
3724	NTIS, PC A05/MF A01 - GPO	TI84017317	MN -78	9:47878
3739	NTIS, PC A10/MF A01 - GPO $6.50	TI85001607	MN -80	9:47812
3750	NTIS, PC A16/MF A01 - GPO	TI84016298	MN -2	9:49308
3766	NTIS, PC A05/MF A01; 1 - GPO (GPO Dep.)	DE84014580	MN -80	9:47821
3776	NTIS, PC A05/MF A01 - GPO	TI85001605	MN -80	9:47879
3792	NTIS, PC A03/MF A01 - GPO* $4.00	TI84901883	MN -78	9:47809
3812	NTIS, PC A05/MF A01 - GPO	TI84016420	MN -70	9:47534
3868	NTIS, PC A03/MF A01 - GPO	TI84016810	MN -77	9:47880
3888	NTIS, PC A05/MF A01 - GPO	TI84015873	MN -78	9:47785
3893	NTIS, PC A05/MF A01 - GPO* $4.75	TI84901914	MN -80	9:47881
3929	NTIS, PC A04/MF A01 - GPO	TI84017274	MN -80	9:47989
3940	NTIS, PC A06/MF A01 - GPO $5.00	TI85900052	MN -70	9:47559
3951	NTIS, PC A03/MF A01 - GPO $3.75	TI85002084	MN -2	9:49324
4011	NTIS, PC A14/MF A01 - GPO $8.00	TI85002091	MN -80	9:47810
NUREG/TR-				
0024	NTIS, PC A03/MF A01 - GPO*	TI84901966	MN -78	9:47893
0050	NTIS, PC A02/MF A01 - GPO*	TI84901965	MN -78	9:47892
NVO-				
283	NTIS, PC A05/MF A01 (GPO Dep.)	DE85001349	STD -70	9:47535
284	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE85001350	STD -70	9:47536
NYSERDA-				
84-11	NYSERDA, Two Rockefeller Plaza, Albany, NY 12223	TI84901478	MN -95d	9:48025
84-12	NYSERDA, Two Rockefeller Plaza, Albany, NY 12223	TI84901830	MN -95d	9:48026
84-14	NYSERDA, Two Rockefeller Plaza, Albany, NY 12223	TI84901481	MN -95f	9:48095
OA-tr-				
2554	NTIS (US Sales Only), PC A03/MF A01; 1	DE84901840	MN -95d	9:48085
ORAU/IEA-				
84-9(M)	NTIS, PC A04/MF A01 (GPO Dep.)	DE84017162	MN -13	9:48096
ORNL-				
4972/ R2	NTIS PC E03/MF A01 (GPO Dep.)	DE84017312	MN -34C	9:48777
6078	NTIS, PC A09/MF A01; 1 (GPO Dep.)	DE84017630	STD -90d	9:47239
ORNL/NSIC-				
200-Vol.3-No.8	*See* NUREG/CR-2000-Vol.3-No.8	TI85001935	MN -80	9:47864
221	*See* NUREG/CR-4011	TI85002091	MN -80	9:47810
ORNL/NUREG/TM-				
421	*See* NUREG/CR-1829	TI84017651	MN -78	9:47784
ORNL/Sub-				
79-21453/ 17	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84017314	MN -20a	9:48905
81-13846/ 1-06	NTIS, PC A15/MF A01; 1 (GPO Dep.)	DE84016681	MN -78	9:47990
81-61615/ 1	NTIS, PC A07/MF A01 (GPO Dep.)	DE84016642	MN -95d	9:48027
84-17457/ 1	NTIS, PC A05/MF A01 (GPO Dep.)	DE84016677	STD -97b	9:47768
ORNL/TM-				
8631	NTIS, PC A07/MF A01 (GPO Dep.)	DE84017635	MN -70B	9:47560
8890	*See* NUREG/CR-3460	TI84015734	MN -78	9:47871
9028	*See* NUREG/CR-3617	TI84016399	MN -78	9:47873
9187	NTIS, PC A03/MF A01 (GPO Dep.)	DE84017638	STD -86	9:47482
9198	NTIS, PC A04/MF A01 (GPO Dep.)	DE84017477	MN -13	9:48271
9238	*See* NUREG/CR-3888	TI84015873	MN -78	9:47785
9292	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE84016516	STD -80	9:47813
9350	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE85001934	MN -11	9:48447
ORO-				
5126-232	*See* DOE/ER/05126-232	DE85001613	MN -34C	9:48737
PB-				
84-173806	NTIS, PC A03/MF A01			9:47466
84-175942	NTIS, PC A06/MF A01			9:48097
84-178060	NTIS PC $19.50/MF $4.80			9:47930
84-178078	NTIS PC $223.50/MF $15.00			9:47931
84-178086	NTIS PC $80.00/MF $8.10			9:47932
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84-184969	NTIS, PC A14/MF A01			9:47579
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84-194612	NTIS, PC A02/MF A01			9:48507
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84-200872	NTIS, PC A05/MF A01			9:48452
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84-201532	NTIS PC E03/MF E03			9:47348
84-201573	NTIS, PC A02/MF A01			9:48462
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84-201631	NTIS, PC A02/MF A01			9:48463
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84-204858	NTIS PC E07/MF E07			9:48470
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84-204916	NTIS PC E03/MF E01			9:47580
84-204999	NTIS, PC A02/MF A01			9:47581
84-205582	NTIS PC E04/MF E04			9:48628
84-205681	NTIS PC E04/MF E04			9:48147
84-206028	NTIS PC E04/MF E01			9:47448
84-206309	NTIS PC E04/MF E04			9:48644
84-206325	NTIS PC E03/MF E03			9:48645
84-206671	NTIS PC E04/MF E04			9:48101
84-206937	NTIS, PC A04/MF A01			9:47976
84-207067	NTIS, PC A05/MF A01			9:47755
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84-207430	NTIS, PC A04/MF A01			9:48028
84-207554	NTIS, PC A18/MF A01			9:48484
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84-209386	NTIS, PC A03/MF A01			9:48472
84-209394	NTIS, PC A12/MF A01			9:48564
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84-210012	NTIS, PC A02/MF A01			9:48592
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84-213883	NTIS, PC A02/MF A01			9:47324
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84-215094	NTIS, PC A02/MF A01			9:47459
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PNL-				
4163	*See* NUREG/CR-2499	TI84017319	MN -15	9:47568
5124	*See* NUREG/CR-3739	TI85001607	MN -80	9:47812
5168	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE85001306	MN -70	9:47540
5202	*See* NUREG/CR-3951	TI85002084	MN -2	9:49324
5209	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84017437	MN -86	9:47566
5211	NTIS (US Sales Only), PC A06/MF A01 (GPO Dep.)	DE85001779	MN -78	9:47786
5223	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE84017275	MN -95a	9:48014
5238	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE85001770	MN -60	9:47735
5242	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE85001366	MN -11	9:48475
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2114	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84017066	STD -20a	9:48840
2117	NTIS, PC A03/MF A01 (GPO Dep.)	DE85002125	STD -20a	9:48841
2124	NTIS, PC A03/MF A01 (GPO Dep.)	DE85002116	STD -20e	9:48842
2125	NTIS, PC A02/MF A01 (GPO Dep.)	DE85002130	STD -20f	9:48906
2133	NTIS, PC A02/MF A01 (GPO Dep.)	DE85002126	STD -20f	9:48843
2135	NTIS, PC A02/MF A01 (GPO Dep.)	DE85002123	STD -20f	9:48844
2138	NTIS, PC A02/MF A01 (GPO Dep.)	DE85002128	STD -20g	9:48845
2140	NTIS, PC A03/MF A01	DE85002114	STD -20g	9:48846
2142	NTIS, PC A02/MF A01 (GPO Dep.)	DE85002127	STD -20g	9:48847
2143	NTIS, PC A02/MF A01 (GPO Dep.)	DE85002124	STD -20g	9:48907
2145	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85002133	STD -20d	9:48848
2146	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85002129	STD -20e	9:48908
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2822-EPA	NTIS, PC A05/MF A01	DE84901925	MN -13	9:47963
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219	NTIS (US Sales Only), PC A05/MF A01; 1	DE84901961	MN -79	9:47800

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4131	NTIS (US Sales Only), PC A02/MF A01; 1	DE84901858	MN -79	9:47801
4147	NTIS (US Sales Only), PC A02/MF A01; 1	DE84901857	MN -80	9:47891
RL-				
83-114	*See* PB-84-206309			9:48644
SAI-				
83/ 1125-Vol.1	*See* NUREG/CR-3665-Vol.1	TI85900067	MN -78	9:47875
84/ 1010-Vol.2	*See* NUREG/CR-3665-Vol.2	TI85900066	MN -78	9:47876
84/ 3037-Vol.3	*See* NUREG/CR-3665-Vol.3	TI85900065	MN -78	9:47877
SAND-				
82-1580	*See* NUREG/CR-3190	TI85001945	MN -79	9:47869
83-0137C	NTIS, PC A16/MF A01; 1	DE83010276	STD -59c	9:47638
83-1191C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84008027	MN -88	9:47402
83-1617	*See* NUREG/CR-3418	TI85001389	MN -78	9:47870
83-1770	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85001149	MN -94ce	9:47902
83-1877	NTIS, PC A10/MF A01; 1 (GPO Dep.)	DE85002132	STD -70	9:47541
83-1892C	NTIS, PC A03/MF A01 (GPO Dep.)	DE84017255	MN -45	9:48419
83-1894C	NTIS, PC A02/MF A01 (GPO Dep.)	DE84017254	MN -45	9:48420
83-1909	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85001148	MN -60	9:47736
83-1960	*See* NUREG/CR-3776	TI85001605	MN -80	9:47879
83-2132	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85001147	MN -32	9:48318
83-2209C	NTIS, PC A03/MF A01 (GPO Dep.)	DE84012657	MN -4	9:47542
83-2314	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85002086	MN -94cc	9:47903
83-2372C	NTIS, PC A02; 3 (GPO Dep.)	DE84006292	MN -70	9:48179
83-2597C	NTIS, PC A02/MF A01 (GPO Dep.)	DE84012905	MN -90d	9:47295
83-8018	NTIS MF A01; 2	DE84000929	STD -62c	9:47617
84-0260	NTIS, PC A03/MF A01 (GPO Dep.)	DE85000214	MN -25	9:48421
84-0419C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84017421	MN -80	9:47882
84-0542C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85000066	MN -34	9:48406
84-0599C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85000068	MN -38	9:48338
84-0609C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84016113	MN -25	9:48360
84-0650C	NTIS, PC A02/MF A01 (GPO Dep.)	DE85001362	MN -25	9:48236
84-0660	*See* NUREG/CR-3724	TI84017317	MN -78	9:47878
84-0769C	NTIS, PC A03/MF A01 (GPO Dep.)	DE84015708	MN -94c	9:47904
84-0956	NTIS, PC A02/MF A01 (GPO Dep.)	DE85001883	STD -66c	9:47726
84-1036C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84012276	MN -37	9:48400
84-1052C	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84017422	MN -25	9:48180
84-1167	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE84017456	MN -63	9:47609
84-1170C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85000064	MN -37	9:48414
84-1187C	NTIS, PC A02/MF A01 (GPO Dep.)	DE84016766	MN -25	9:48407
84-1259C	NTIS, PC A02/MF A01 (GPO Dep.)	DE85001792	MN -25	9:48181
84-1347C	NTIS, PC A02/MF A01 (GPO Dep.)	DE85001606	MN -25	9:48182
84-1410	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85001320	MN -32	9:49319
84-1561	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE85002135	STD -91	9:47463
84-1663C	NTIS, PC A02/MF A01 (GPO Dep.)	DE84016119	MN -25	9:48161
84-1760	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85000212	MN -21	9:48909
84-1789C	NTIS, PC A02/MF A01 (GPO Dep.)	DE84017380	MN -80	9:48778
84-1816	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85002137	MN -28	9:48376
84-1902C	NTIS, PC A02/MF A01 (GPO Dep.)	DE85001903	MN -37	9:48237
84-7010	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85001952	MN -63	9:47604
84-7162C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84017088	MN -63	9:47610
84-8016	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE85002151	MN -32	9:48415
SCI-				
4015566	NTIS, PC A14/MF A01; 1 (GPO Dep.)	DE84015566	MN -97c	9:47991
SCPRI-RM-				
10-1983	NTIS (US Sales Only), PC A03/MF A01	DE84751755	MN -11	9:48495
SCPRI-RT-				
3-1983	NTIS (US Sales Only), PC A03/MF A01	DE84751754	MN -11	9:48496
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351	State Electricity Commission of Victoria, Melbourne, Australia			9:47325
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253-1750	NTIS, PC A10/MF A01; 1	DE84013032	STD -59a	9:47639
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231-2427	NTIS, PC A03/MF A01 (GPO Dep.)	DE84013019	STD -61A	9:47582
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SLAC-PUB-				
3405	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84017640	MN -34D	9:48716
SMRE-Trans-				
7276-T	NTIS (US Sales Only), PC A02/MF A01; 1	DE84901844	MN -90i	9:47404
SOLAR/1017-				
80/ 04	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84017366	MN -59	9:47640
SOLAR/2029-				
80/ 03	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84017362	MN -59	9:47641
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83-R-4861-45	*See* PB-84-207869			9:48104
SREL-				
16	NTIS, PC A02/MF A01 (GPO Dep.)	DE85001951	MN -11	9:48518
SSS-R-				
83-6228	*See* AD-A-141482/0			9:48423
STMPO-				
062	*See* DOE/SF/10501-062	DE84017039	MN -62a	9:47615

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SWRI-				
05-6800-210/ 1	*See* AD-A-141701/3			9:47443
7531	*See* AD-A-141688/2			9:48319
TAC-				
4901901	Technology Application Center, Univ. of New Mexico, Albuquerque, NM 87131	TI84901901	ND -94d	9:47574
4901902	Technology Application Center, Univ. of New Mexico, Albuquerque, NM 87131	TI84901902	ND -13	9:47575
TF-				
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TID-				
27727	NTIS, PC A02/MF A01 (GPO Dep.)	DE84017615	MN -94c	9:47905
TKK-F-A-				
548	*See* PB-84-214253			9:49318
TR-				
4	*See* AD-A-142213/8			9:48248
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84-30	NTIS (US Sales Only), PC A02/MF A01; 1	DE84901557	MN -28	9:48383
84-31	NTIS (US Sales Only), PC A02/MF A01	DE84901559	MN -34D	9:48735
TVA/OP/ECR-				
83/ 58	NTIS, PC A02/MF A01; 1	DE84901498	MN -98E	9:47996
84/ 42	NTIS, PC A05/MF A01; 1	DE84901082	MN -13	9:48132
TVA/OP/EDT-				
84/ 28	NTIS, PC A11/MF A01; 1	DE84901968	MN -90a	9:47326
84/ 29	NTIS, PC A10/MF A01; 1	DE84901972	MN -96	9:48153
84/ 34	NTIS, PC A13/MF A01; 1	DE84901973	MN -95d	9:48029
84/ 36	NTIS, PC A03/MF A01	DE84901971	MN -90i	9:47327
TVA/PUB-				
84/ 72	NTIS, PC A03/MF A01; 1	DE85900075	MN -61F	9:47588
84/ 75	NTIS, PC A02/MF A01	DE85900073	MN -4	9:48282
84/ 76	NTIS, PC A06/MF A01; 1	DE85900071	MN -90i	9:47350
84/ 78	NTIS, PC A02/MF A01; 1	DE85900076	MN -11	9:48565
UCID-				
18967-Vol.1	*See* NUREG/CR-2189-Vol.1	TI84017628	MN -78	9:47866
19988-Vol.2	*See* NUREG/CR-3660-Vol.2	TI84014704	MN -38	9:47874
20089	NTIS, PC A04/MF A01 (GPO Dep.)	DE85001927	MN -32	9:48408
20135	NTIS, PC A09/MF A01; 1 (GPO Dep.)	DE85001766	MN -38	9:48409
20164	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84017206	MN -11	9:47883
20166-Vol.2	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE85002141	MN -20	9:48910
20167	NTIS, PC A02/MF A01; 1	DE85001799	MN -32	9:49320
20169	NTIS, PC A02/MF A01 (GPO Dep.)	DE85001800	MN -32	9:49321
20174	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE85001768	MN -70	9:48183
30201	NTIS, PC A02/MF A01 (GPO Dep.)	DE85001767	MN -20	9:48849
30203	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE85001765	MN -32	9:49322
30204	NTIS, PC A11/MF A01; 1 (GPO Dep.)	DE85001586	MN -32	9:49325
UCLA/PPG-				
815	NTIS, PC A10/MF A01; 1 (GPO Dep.)	DE85001155	STD -20c	9:48911
816	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85001145	STD -20c	9:48912
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15606	*See* AD-A-141688/2			9:48319
52000-84-7	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE85001472	STD -2	9:49309
90478	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE85001748	MN -37	9:48416
90638	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84017415	MN -25	9:48324
90831	NTIS, PC A02/MF A01 (GPO Dep.)	DE85001750	MN -34	9:48654
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